FACULDADE DE CIÊNCIAS SOCIAIS E HUMANAS
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# Strategies for Combining e-Learning and Serious Games

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Tese apresentada para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Media Digitais, realizada sob a orientação científica de Professor Doutor Carlos Correia e Professor Doutor João Correia de Freitas

DECLARAÇÕES

Declaro que esta Tese é o resultado da minha investigação pessoal e independente. O seu conteúdo é original e todas as fontes consultadas estão devidamente mencionadas no texto, nas notas e bibliografia.

O candidato, _____

Lisboa, 28 de Julho de 2016

Declaro que esta Tese se encontra em condições de ser apreciada pelo júri a designar.

O orientador,

_____

Lisboa, 28 de Julho de 2016

O coorientador,

_____

Lisboa, 28 de Julho de 2016

*To my parents,*
*for everything.*

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**ABSTRACT**

**STRATEGIES FOR COMBINING E-LEARNING AND SERIOUS GAMES**

**ANDREIA TELES VIEIRA**

To analyze multiple valences of learning systems in e-Learning is a challenge. Education and communication are in constant (r)evolution. The phenomena of globalization affect directly and/or indirectly most areas of human activity and learning educational systems are no exception.

This doctoral dissertation focuses on the context and problematization of different strategies in the use of game-based learning and the use of e-learning strategies. The relationship between the use of tools and digital strategies is a key point of this thesis.

The use of serious games in the digital learning context in Portugal is not a common practice in the educational context. Thus, this thesis was developed to define the use of e-learning and serious games strategies, proposing a pedagogical approach to the use of serious games in the classroom in order to motivate and consolidate knowledge acquisition. The construction of serious games in order to meet the identified needs was the object of analysis of the controlled experiment. The serious game "Alpha Patrol" was conceptualized, developed and tested under the responsibility of the Research Center for Interactive Technologies.

The research project involved different stages of the investigation in order to adopt a strategy of analysis, which sometimes proved to be difficult. Research and develop serious games in Portugal is often faced with indifference or even hostile environments. Prejudice to play as a form of knowledge acquisition (especially in the classroom) still exists. With this in mind, in the case study it was decided that the digital object had to present a hybrid structure: a book and the serious game.

The controlled experiment allowed to set the parameters for the serious game created, the motivation elements, the relevance of using different strategies like the book, quizzes and learning medals.

KEYWORDS: serious games, e-Learning, digital learning, strategies, game-based learning, digital learning badges

## RESUMO

## ESTRATÉGIAS DE IMPLEMENTAÇÃO DE E-LEARNING E JOGOS SÉRIOS

## ANDREIA TELES VIEIRA

Analisar as múltiplas valências dos sistemas de aprendizagem em e-learning constitui um desafio. A educação e a comunicação estão em constante (r)evolução. Os fenómenos da globalização afetam de forma direta e/ou indireta a maioria das áreas da atividade humana e os sistemas de ensino aprendizagem não são exceção.

A relação entre a utilização de ferramentas e as estratégias digitais é um ponto fulcral desta dissertação. Nesta dissertação doutoral teve como objeto a contextualização e problematização das diferentes estratégias na utilização de game-based na aprendizagem e estratégias de utilização do e-learning.

A utilização de jogos sérios no âmbito das aprendizagens digitais em Portugal não é pratica comum no contexto educativo. Assim, esta dissertação foi desenvolvida para a definição de estratégias de utilização dos jogos sérios e e-learning, propondo uma utilização pedagógica dos jogos sérios em sala de aula por forma a motivar e consolidar conhecimentos adquiridos. A construção de jogos sérios com o intuito de corresponder às necessidades foi o objeto de análise da experiência controlada. O jogo sério "Alpha Patrol" foi conceptualizado, desenvolvido e testado sob responsabilidade do Centro de Investigação para Tecnologias Interactivas.

O projeto de investigação envolveu diferentes etapas da investigação de forma a adoptar uma estratégia de análise, que por vezes, se mostrou difícil e ingrata. Investigar e desenvolver jogos sérios em Portugal confronta-se com ambientes indiferentes ou mesmo hostis. O preconceito de jogar (em especial no espaço de sala de aula) ainda existe. No estudo de caso que a dissertação apresenta e desenvolve foi decidido que, face a algumas limitações sociais e culturais, o objecto digital a ser analisado apresenta-se uma estrutura híbrida: livro e jogo dele extraído.

A experiência controlada permitiu definir os parâmetros sobre o jogo sério criado, os elementos de motivação, a pertinência na utilização de diferentes estratégias como o livro, os quizzes e as medalhas de aprendizagem.



PALAVRAS-CHAVE: jogos sérios, e-Learning, aprendizagens digitais, estratégias, medalhas digitais de aprendizagem

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## 1. INTRODUCTION

The digital learning systems are gradually occupying space in all levels of education. The pace at which this progression happens is not identical, it varies from system to system, and country to country. However more or less evident, it can be considered that, in all teaching systems there are already areas in which the digital learning is visible and efficient. The preparation of a thesis that sets of from this *status quo* presents stimuli and difficulties. And both are empowered when adding the serious games.

Having this in mind, the objective of the study was to analyze the e-learning systems, considering both the difficulties and the gains. Accordingly, we sought to understand the use of serious games in the school environment and in the learning process. Although this is a relatively poorly addressed *cluster* when it comes to research done in Portugal, this theme has been analyzed by several research centers and universities in other countries. The Serious Games Institute, the FutureLab, the Serious Games Interactive, the Serious Games Society, the Center for Computer Games Research, the Serious Games and Virtual Worlds Team - Ulster University and Center for Serious Gaming - Delft University of Technology, are some examples of institutions which study the context and use of serious games in learning areas. Research centers and companies in Europe have even created an alliance in this study field, the GALA - Games and Learning Alliance Network of Excellence for serious games - a network of interaction and exchange of experiences dedicated to the investigation of serious games in the educational context.

We can not fail to mention that some of the more prominent researchers in the field are analyzing the use of different digital tools in the educational context. Nicholas Negroponte (founder of MIT Media Lab, the Wired magazine and the project One Laptop Per Child), in particular, advocates the use of educational material for children. In his project "one laptop per child", Negroponte says that children need "children books that read themselves, cartoons with titles, games with phonetics and letters" (Negroponte, 2012). This emphasizes that both game designers and researchers continue to study the form of integration of serious games in

education, making it the active object in their work schedules and research priorities.

When mentioning the topics of learning and digital learning, it is essential to point the theorists who contributed diametrically to the construction and structure of this study field: Piaget, Papert, Resnick. The studies that S. Papert has done with Jean Piaget in Geneva were very important to the conceptualizations about learning as whe know it. In emphasizing the importance of *knowing how to do*, Jean Piaget has inspired his disciple Papert to use tools in the cognitive construction of pedagogical models based on "learning by doing" (Papert, 1980). The MIT professor spent the second half of the 20th century and the first decade of the 21st century investigating and analyzing the educational models, which we now consider the cornerstone that supports the theoretical basis of *the state of the art* of digital learning. Papert has proposed the construction of mediation models so that students can build objects that are effectively a motor for development: learning by doing.

Following Papert, Resnick's project "Kindergarten forever" states that "new technologies can extend the kindergarten approach, allowing "students" of all ages to continue learning in the kindergarten style and, in the process, to keep growing as creative thinkers" (Resnick, 2009). The researcher proposes that the kindergarten is the place to learn "forever" (virtual and metaphorically speaking).

In this sense, he analyzes the act of playing as one of the necessary cognitive tools for harmonious growth of the landscapes that shape the cognitive learning, any type of learning: digital learning or not. Games are part of our lives since a young age and may have different scales of importance when it comes to social aspects, recreational or even learning. And the game concept, itself, has various branches and extensions, but what we want to focus in this research is the serious games.

To qualify the game as serious means that the goal is not to play *per se*. The game is a learning situation from which the user reaps benefits for his/her learning area. For example, the pilots training in virtual simulation cabins it is considered a serious game.

It should be noted that this tool has proven to be successful in multiple areas of teaching and learning - such as medicine, the military industry or the airline industry – with proven results when using games and simulations. In fact, in recent years several studies were conducted to understand the effective value of games applied to learning, in a broader sense, for various ages and in different areas of knowledge: mathematics (van Eck & Dempsey, 2002), software engineering (Cagiltay, 2007; CONNOLY, Stansfield & Hainey, 2007), civil engineering (Ebner & Holzinger, 2007), management (Kiili, 2007), computer science (Patastergiou, 2009), geography (Tüzün, Yilmaz-Soylu, Karakus, The Sign & Kizilkaya, 2009), linguistic (Liu & Chu, 2010) and science (Chang, Peng & Chao, 2010).

According to Van Rosmalen, & Westera (2012) teachers use simple tools that can be considered as a serious game: this is the case of the use of wikis, a sharing and collaboration document with the goal of creating a single and cohesive text. There are teachers who use templates of serious games that already exist, adding or removing content for their lessons (Hummel, Geerts, Slootmaker, Kuipers, & Westera, 2013) or even those that use, in the organization of their classes, a game software with simple and easy access editors (Torrente, Del Branco, Marchiori, Moreno-Ger, & Fernández-Manjón, 2010; Overmars, 2004)

Some authors consider that the use of games in learning can be an added advantage:

> "a problem for serious gaming is the notion that they may be perceived as tedious when they are designed for learning; the designers try to make them realistic as they want the players to learn. The entertainment purpose becomes a secondary concern although the anticipation of fun is what brings players to play those games in the first instance. While teaching using textbooks is efficient and can help pupils learn it often does not lead to a deep understanding. Deep understanding takes time, reflection, and active engagements, which are strengths of video games (Bertacchini, Bilotta, Pantano, & Tavernise, 2012).

Lunn, Khalaf, Hussain, Al-Jumeily, Pich, & McCarthy (2016) mention the

advantages of integration of serious games with e-learning

> "further advantages of combining serious games with Open Learning concern building on the proper formation of hypotheses and problem solving abilities linked to experiential memory, which is, strongly developed in a gaming setting. Additionally, in a gaming setting, immediate feedback is given to the user so that they can recognise and assess their errors and re-evaluate their expectations. The learners are then able to apply their previous experiences to similar situations, so that they are able to properly "debug" their knowledge to form a more generalised approach, rather than applying them to specific scenarios".

However, the development of serious games creates problems of various kinds, including the economic aspect "despite the intense interest in games, it is important to realise that developing games for learning can be very complex and costly and still provides significant challenges" (Boyle et al, 2016)

However, there are challenges of different order, such as teachers training, so that the integration of serious games is done properly in the classroom "currently there exists a lack of training on the proper integration of games within the traditional classroom, both on the pre-service and in-service level. As Becker (2007) stated "teachers cannot be expected to embrace digital games as a tool for learning unless they have a sound understanding of the potential, as well as the limitations, and are con dent in their ability to use games effectively to enhance learning" (p. 478)." (Dabbagh et al, 2016)

Dabbagh et al (2016) adds that this need is mirrored in the 2014 study, which confirms the need for teachers training, so they are able to use the serious games in the classroom. The will exists, however, the technique has to be acquired "the need for professional development was confirmed by a recent survey, which found that teachers are interested in using games, but need more resources related to identifying good games, mapping games to standards, and using GBL lesson plans (Takeuchi and Vaala 2014). This presents the opportunity for the

development formal curricula, backed by evidence-based best practices, as a means of increasing the adoption of GBL". (idem)

With this in mind, this research project involved different stages of investigation in order to adopt a strategy of analysis, which sometimes proved to be difficult. Research and develop serious games in Portugal is often faced with indifference or even hostile environments. Prejudice to play as a form of knowledge acquisition (especially in the classroom) still exists. With this in mind, in the case study it was decided that the digital object had to present a hybrid structure: a book and the serious game.

The whole process of the game construction - materials, characterization, planning, development, test - was conducted in order to respond to the initial questions about games integration in the educational context and the results of its use. The creation of two sets of games constituted a starting point. Later, in the creation of the last serious game, the integration of the physical book with the game was an added value, both for integrating the game in a school context, and for measuring the learning results.

### 1.1 Objectives and research questions

The goal of the study and research on e-learning and serious games aims a double objective: on one hand, investigate the guidelines for the development of e-learning both at the global and the local level; on the other hand, investigate and evaluate the potentiality of the introducing serious games in a classroom context receptive to the use of digital environments.

The specific objective of this study is to develop an empirical research in order to integrate the serious games in digital learning, understood as a tool to be used by teachers, educators, tutors and students. The investigation of the case study aims to explore and

analyze the different strategies used in digital learning and the specific characteristics of games as a learning tool.

It is important though to emphasize that the use of serious games in the context of the classroom by teachers does not happen without some initial difficulties. Despite the ups and downs for the case study, it was possible to provide an efficient learning environment for for children with the use of two different tools: the book and the serious game. In the case study the book "Grandes Catástrofes" by Isabel Alçada and Ana Maria Magalhães gave rise to a serious game and it was in this context that teachers and students used both tools, given that the learning objectives were the following:

1. learn from the experience: use what was being displayed / played immediately;

2. reflect on the learning strategy;

3. have a proof of knowledge and learning feedback.

After defining the objectives, the research questions were created in order to respond to the initial hypotheses. The research questions for this thesis are as follows:

1. What are the trends in digital learning?
2. Should serious games be considered a structural tool in the learning process?
3. Can the serious games create motivation in learning?

Both the presentation of the objectives as the research questions are sustained by experiences of researchers, as are the cases of Connolly, Boyle, Hainey, McArthur and Boyle (2012), where they identify the study development needs for this area

> "while empirical evidence concerning the effectiveness of games-based learning was found in the current review, there is a need for more RCTs to provide more rigorous evidence of their effectiveness. More qualitative studies would also

> help to extend our understanding of the nature of engagement in games. To encourage the use of games in learning beyond simulations and puzzles, it is essential to develop a better understanding of the tasks, activities, skills and operations that different kinds of game can offer and examine how these might match desired learning outcomes".

Boyle, Hainey, Connolly, Gray, Earp, Ott, Lim, Ninaus, Ribeiro, Pereira (2015) reported that "several of the studies demonstrating that playing games can change behaviour in a positive way, involved entertainment games. This unintentional learning by playing games is also seen in the studies demonstrating the visual perceptual benefits associated with playing entertainment games. It seems that this "unintentional" learning found in entertainment games could provide insights into engagement and learning in serious games."

For researchers Duncan, Fabola and Miller (2016), when analyzing the prospects for research in the field of serious games until 2025,

> "Worldwide, there are many active researchers and educationalists building virtual worlds or environments to cater for rising student numbers and the changing needs of the 21st Century student. (...) Learning goals and layers of syllabus aligned knowledge must be encoded to enable a useful learning experience for students rather than a repetitive or one time play experience. Thus frameworks for learning, essentially encoding learning theories into programmed environments, goal driven processes and adding variation for experiential learning is a blue sky research goal".

These researchers end their analysis with the need for development of the area, "As student numbers grow and educational technologies reach into the outback, the desert and the mountain, educational tools will be required to have far easier interfaces for designing appropriate scenarios, games and exercises for students of all ages. An easy interface for the tutor to edit, adapt or maintain is essential. The offered environment must have a built in and large variety of exercises, scenarios and assessments as well as changeable, adaptive and entertaining avatars with randomised movement of information objects."

### 1.2 Structure of the Thesis

This dissertation is structured in five chapters. The opening chapter introduces the theme, objectives and questions for research. It also shows a global perspective on the use of e-learning and serious games, and introduces some references that will be analyzed in detail along the dissertation.

The second chapter presents a literature review and the state of the art in this field of study. The main topics of analysis are associated with the digital revolution - foundations, evolution and trends - both in the communication and education perspectives. In the field of education are analyzed strategies in the digital learning, particularly in the use of serious games - their characteristics, functions and actions of intervention in education.

The third chapter is dedicated to the research methodology: the research methods in the digital media area and the strategies adopted in the design of the research. In the first phase of this study, there is a literature review sought to analyze the different strategies for the use of e-learning and game based learning. In a second phase, we proceeded to the description of the different case studies and their phases of development: concept, implementation, analysis. In a third phase, a descriptive analysis of the case study and, subsequently, the inquiry in the field with the selection of a sample with the characteristics necessary for conducting the study.

In the fourth chapter, it is presented the case study of this dissertation – a 3 year project with the main goal to create a set of serious games to provide young people with active and pleasant forms to acquire information about the function, operation and utility of the insurance industry. Therefore, the case studies presented are:

1. Presentation of the first set of serious games: concept, development, analysis and critical reflection;
2. Presentation of the relationship between the book and the serious game from it

developed: context, concept, implementation, a description of the controlled experiment, results and prospects.

In this chapter we assess the results obtained in the study and we ended it with an analysis of the prospects and opportunities of the subject of study for the future.

The fifth chapter is devoted to the final contributions of this dissertation: the attempt to answer the research questions, the limitations and problems, the goals achieved, and suggestions for future work of research. It is a summary of the dissertation and the research project, as we believe the contributions of this study and suggestions for different lines of research are key points in the process to allow future developments.

The list of references completes the dissertation.

# 2. E-LEARNING AND SERIOUS GAMES: FROM THE STRATEGIES TO THE DEVELOPMENT

Education and communication are in constant (r)evolution. The phenomena of globalization affect direct and/or indirect most areas of human activity and the education systems are no exception. Before the World Wide Web was in full operation, the information was not so fast. In fact, with the increase of bandwidth, the distance became shorter and the information more accessible.

Despite the demonstration of resistance, the learning systems and the digital tools from the second decade of the 21st century are being used in some classroom classes, such as for example the flipped learning, presenting, in this way, a harmony between the digital and the classroom environments. However, it seems to be necessary to change some characteristics of the school faculty in order to cope with the demonstration of competences, which is required in our days. In fact, when comparing to the business world, the individual competences assessment is made and an effective demonstration of mastery required when it comes to dominate those skills.

The relationship between the use of tools and the digital strategies is a central point of this dissertation. In this chapter, fundamental constituent of this thesis, we intend to approach, contextualize and problematize the different strategies on the use of game-based learning and the strategies for the use of e-elarning. It is considered essential in the analysis of the paradigm shift the development of the communication / education binomial.

## 2.1 Foundations of the Digital Revolution

The problems connected with the digital revolution require a thorough knowledge of the lines of evolutionary communicational processes, which benefited from the scientific

advances of mathematical languages, in particular in the area of binary codes and the hexadecimal digits languages. The theories of information generated processes and effective procedures to encode the communication between man and machine. Consequently, the technology concretised scientific advances with the achievement of progressively more ergonomic machines and with better *performance*. The digital communication directly benefits from both the scientific advances, as well as the technology directly subsidiary to them.

Immediate access to information, interactivity, the cult of I, are characteristics that are inherent to the evolution of digital communication. In the preface of his book "Alone Together ", Sherry Turkle stresses the changes in the humans, social life and even the intrinsic characteristics of society and of the human being in the last thirty years.

> "Thirty years ago, when I joined the faculty at MIT to study computer culture, the world retained a certain innocence (...) While my computer science colleagues were immersed in getting computers to do ingenious things, I had other concerns. How were computers changing us as people? My colleagues often objected, insisting that computers were "just tools". But I was certain that the "just" in that sentence was deceiving. We are shaped by our tools. And, now, the computer, a machine on the border of becoming a mind, was changing and shaping us." (Turkle, 2011)

To better understand these changes, it will be necessary to examine the common denominator of all major advances in the transition from analogue to digital systems: the binary encoding.

Dowbor (2013) refers that the starting point is the adoption of a binary code

> "Instead of writing for example the letter "a", I can decide, by convention, its replacement by a combination of successive bits:"0" and "1". I.e., replaced a graphical representation, the "a", a drawing, by an abstract symbol that consists in the combination of two digits. If you opt for groups of 8 digits, each letter of the alphabet may be replaced by something like, for example, 00101100. As it is two

> digits, with 8 positions, we have 256 combinations, allowing give expression not only the alphabet, as numbers, to a smaller there a timbre determined, to a point of color on a screen, and so on. And if we increase the size of the digital group of 8 to 16 positions, for example, we may include all Chinese characters, because we have at our disposal 65.516 combinations". (Dowbor, 2013)[1]

In putting up the binary encoding in series of bits, which are commony knowned as bytes - in sequences of 8.16, 32, 64, 128, 256, ... - writing has a double existence: the traditional and the digital.

From the moment in which it was possible to scan and store the information contained in analog support, we observed an exponential growth both in the amount of publications issued, and in the number of users. This has affected all areas of activity: music, the press, the radio, the television, the cinema and the areas of education and research.

Six phenomena of the scientific and technological order contributed to this evolution:

1. The machines have processing capabilities that, according to Moore's Law, duplicate every eighteen months;

2. Exponential increase in memory capacity in the computers where we save the information;

3. The miniaturization of electronic devices. The devices are increasingly small so as to become more practical and lightweight to carry;

1Translation from the original reference: "em vez de escrever por exemplo a letra "a", eu posso decidir, por convenção, a sua substituição por uma combinação sucessiva de bits:"0" e "1". Ou seja, substituímos uma representação gráfica, o "a", um desenho, por um símbolo abstrato que consiste na combinação de dois dígitos. Se optarmos por grupos de 8 dígitos, cada letra do alfabeto poderá ser substituída por algo como, por exemplo, 00101100. Como se trata de dois dígitos, com 8 posições, podemos ter 256 combinações, permitindo dar expressão não apenas ao alfabeto, como aos números, a um lá menor de um timbre determinado, a um ponto de cor numa tela, e assim por diante. E se aumentarmos o tamanho do grupo digital, de 8 para 16 posições, por exemplo, poderemos incluir todos os caracteres chineses, pois temos à nossa disposição 65.516 combinações" (Dowbor, 2013)

4. The screens that provide access to information have increasingly better definition, are thinner and more flexible;

5. The compression and decompression algorithms (codec)[2] are more powerful: to compress the information it allows it to "navigate" with greater speed in the network of networks; and when this compressed information reaches the destination machine, the digital information is "decompressed" quicly and the information is returned with smaller loss of quality.

6. The telematics network increases the bandwidths available, making the exchanges of information faster, in most cases.

The increasing capability of processing, associated to the plasticity and the ergonomics of the tools that allow for the construction of products which integrate good quality video, 3-dimensional images, sound and texts, have resulted in the creation of applications in all areas of knowledge. Learning to build multimedia products can be considered an important data for the reflection on models and communicational strategies.

In this sense, Carlos Correia, reflects on the encoding and interactivity of multimedia products "the flexibility inherent in digital coding is catalyzed by encouragement of interactivity, since any mass of multimedia information requires the user to dialog, in order to withdraw all the benefits inherent to its arborescent structure, or in warp" (Correia, 1998)[3]

Note that the lack of knowledge of the rules of languages does not allow the reflection about the finished products. On this subject says Fred Inglis that "the theory in the human sciences must be closely linked to the practice. (...) have a domain even elementary and schematic of what is happening in the wires when you use the phone, or minimally know how

2 CoDec is the acronym encoder / decoder hardware device or software that encodes / decodes signals.
3 Translation from the original reference “a flexibilidade inerente à codificação digital é catalisada pelo incentivo da interatividade, uma vez que qualquer massa de informação multimédia exige do utilizador diálogo, a fim de se poderem retirar dela todos os benefícios inerentes à sua estruturação arborescente, ou em teia”.

the points and lines arrive to the TV picture tube to form the image is, firstly, to change the position of the theorist in relation to its theories, to its policy and its training"(Inglis, 1993: 40-41)[4].

To know and master the tools we use to communicate involves an intrinsic knowledge of the procedures inherent to the tools used.

In this sense, we intent to make a brief description of the evolution of the processes in the different areas of communication and technology: the music industry, press, radio, cinema, television, publishing industry and higher education.

### 2.1.1 From vinyl to MP3

The evolutions of the analogue processes to achieve digital processes were visible and are being decisive in different areas of the communication, and the media industry was not the exception.

The music industry was the first to be confronted with digital mutation and to suffer the economic consequences of such a profound transformation. From the beginning the transition of analogic systems for recording, as vinyl, for magnetic tape and then for audio CD didn't cause any profound change in the industry business model. However, analogic formats didn't allow durability and quality playback, because there was always a magnetic head, or a needle, skimming on tape or pieces of plastic. It was impossible to eliminate the noise and, even on the better high fidelity devices, it was present. The exception was the Audio CD, which had laser reading and the encoding was made through powerful compression algorithms.

4 Translation from the original reference "a teoria nas ciências humanas deve estar intimamente ligada à prática. (...) Ter um domínio mesmo que seja esquemático e elementar do que está a acontecer nos fios quando se utiliza o telefone, ou conhecer minimamente o modo como os pontos e as linhas chegam ao cinescópio do televisor para formar a imagem é, em primeiro lugar, mudar logo a posição do teórico relativamente às suas teorias, à sua política e à sua formação"

In 1988 the International Organization for Standardization (ISO) [5] and the IEC (International Electrotechnical Commission) [6] created the MPEG - Motion Picture Expert Group[7] - to standardize the algorithms of compression and decompression used in music, in photo and video. This created the path for the best conditions of dissemination via the Internet of all kinds of sounds and, consequently, piracy with the consequences we know today.

The sound segments seek to resemble the real world trying to give to the listener the perception of the space where the speech moves and where is the sound. However, the complexity to achieve a consensual sound design feature endures: this clash between distinct imaginative capabilities has caused major discontents. The subjectivism with which we appreciate the finished product usually lies on expressions such as "this application has a good (or a bad) sound environment", as the expression of satisfaction or dissatisfaction feelings.

Another bad consequence for the music industry was the ease of collecting musical excerpts, freely, and exchanges them on the Internet. This questioned the existence of one of the most prosperous industries in the world. The massification of this form of accessing music, formerly protected by the rights of record reproduction, propitiated a fruitful environment for piracy to increase. The download of consecutive new singles, even before entering the market, is an inescapable reality that questions the traditional business model of the music industry, such as it existed. It is not our intention to do a moral evaluation or economic process; it's only an observation.

The grave consequences have been noted not only in the music industry, but also in the media industry, more precisely in the press, where the mutations were felt deeply.

[5] International Organization for Standardization (ISO) is the International Organization for Standardization, i.e., is an entity that creates standards or international standards in order to facilitate trade relations between the different countries.

[6] IEC (International Electrotechnical Commission) is the International Electrotechnical Commission is an international organization for standardization of technologies electrical, electronic and related.

[7] Moving Picture Experts Group (MPEG) - In Portuguese Group of Experts on moving images was formed by the ISO to define standards for the compression and transmission of audio and video.

### 2.1.2 The Media Industry: Press

In the first attempts of migration to digital, the press has done no more than mere visual transcripts of what was official printed, but it was soon realized that the Internet users were to getting used to a free access to information. The newspapers websites began to first gain their own personality, and then more information content, in most cases copied from each other's, or purchased from news agencies. The proliferation of news websites became a reality. Consequently, information aggregators began to emerge, which immediately raised the question about the sustainability of a model based on the reproduction of information that is identical, when not even equal from electronic newspaper to electronic newspaper. In accordance with Chyi and Sylvie (2001) "technologically, the Internet phones to seek online refer the world-wide market. Practically, most online phones ductand owned by their print counterparts, which also serves the online editions' primary content providers". (Chyi & Sylvie, 2001)

This transition from the traditional model for the digital model is analyzed by researchers such as Bressers & Kamerer "phones need an online presence to explore cheaper production and distribution methods; to reverse published simultaneously taken evil by building a new basis of young and computer-savvy readers; to develop new advertising revenue potential; and to protect their advertising basis". (Kamerer & Bressers, 1998)

Today it is public that the large majority of publications has serious economic problems, both in the "traditional" area with the printed editions, as with the online edition, whose business model of signatures and advertising is not yet stabilized. However, there is a business model experience that can be a case of guaranteed economic viability: the Wall Street Journal. This model exposes the information in three distinct levels - the rule of three clicks. The first informative layer is free - citizenship. The second layer has more depth of information and, finally, the third corresponds to the third click, being information with extra value for an added tax. Contextualizing, the user from WSJ has free access to information of citizenship. If he/she clicks on a link of interest, it requires a registry, and finally the paid model that allows to have

privileged access to the state of the stock exchange transactions, for example. This is an economic model, which guarantees the survival of the press in “niche" areas, but the same cannot be so easily applied on the generalistic press.

However, it is important to mention that this line of analysis of the media industry, the transition from analog models for digital models has affected the whole area of the so called "social communication" and the radio was not the exception.

### 2.1.3 The Media Industry: Radio

The digitalization of broadcasters was a process that in certain cases has "dehumanized" the radio and eliminated jobs: the replacement of people by robots that autonomously replace operators, reporters and journalists has had as a consequence an impoverishment of radio spectrum. Today, in most cases, after 2am emissions are automatic, or are fully digital. These are emissions recorded previously to be broadcasted after normal work hours.

The entertainment programs are no longer part of the radio broadcast grids, from the moment in which the advertising ceased to finance the grid of the smaller radio stations, that they survive almost only with local announcements and not much more. The full automation of radios, through the scanning of all their processes, is the main agent of change and the exception to this rule - which continues to exist in major broadcasters - entities with national diffusion capacity, private capital or State aid and strong influence in other media.

However, if the radios are underpinned by agents of change in social networks, we believe they will be able, through the confluence of platforms, to find new business models. The existing fusion between the radio and the different platforms such as YouTube, Facebook or Twitter are starting to become a rule and not the exception. The digital communication on radio implies new procedures and techniques to maximize this means of communication “This

is not a Internet radio but a sound information along with other elements written and visual arts with capacity of links, navigation, rupture of the timing for releasing the user timeline and especially to access when you want to". (Cebrián Herreros, 2001: 21)[8]

Moreover, the confluence of platforms is extensible to the television, the editorial by industry and even to education.

The use of different planning grids and the advantages of uses are to be exploited "Internet radio is crossing an interesting visual path, that is still experimental, but that we cannot ignore. The sound landscapes, now visible on the screen, show the listeners/user a new radio feature that once was occult and mysterious. Indeed, in Internet the user experiences a total freedom. And it's the interface and website interactivity that are going to engage the user and invite him to assume an active role in terms of content production." (Silva, 2012)

### 2.1.4 The Media Industry: Cinema

The introduction of "the digital" in the world of cinema has encountered some resistance from the filmmakers. During almost a century the acquisition of images was performed through film sensitization. I.e., its form of operation took place through a chemical reaction in a material, the film, and the light captured. The film director, David Hancock, clarifies that "since 1889, 35mm has been the principal film projection technology, taking audiences from the slapstick of the silent age, through the great musicals of the sound era, to the epoch of the summer blockbuster" (Hancock, 2011).

The final result of a recorded movie on film is similar to what our eyes see. And the quality of the digital images, that in the first years was questionable, was the main reason for

8 Translation from the original reference: "No se trata tanto de radio por Internet sino de una información sonora acompañada de otros elementos paralelos escritos y visuales con capacidad de enlaces, de navegación, de ruptura del sincronismo para dejar libertada al usuario temporal y espacialmente para que acuda cuando quiera."

this resistance. However, with the more modern codecs it was possible to obtain, through the digital, a superior quality in the recording, which now even allows to capture and shoot three-dimensional films of large production. The quality, the more competitive economic values, storage capacity and the easier distribution all allowed for the progressive acceptance to integrate digital processing in the work routines.

In 2011, Nacock stated that "after 10 years of market priming, movie theaters now are undergoing a rapid transition to digital technology, spurred initially by the rising popularity of 3D films. This is resulting in the rapid decline of 35mm, first losing its status as the dominant cinema technology in early 2012-and then causing it to dwindle to insignificance in four years." (Hancock, 2011)

As has already been mentioned in other fields, one of the problems that affect economically the film industry is the distribution. The recording of illegal movies, piracy through sale and the illegal downloads are the main concern of those who invest big budgets and end up eventually defrauded. With this "perversion" of the system and without an effective business model capable of overcoming the piracy, the film industry is at risk of survival.

The report *Sizing the Piracy Universe* of David Price, director of the company NetNames, states that "the report showed that video streaming consumption of all kinds rose by 170% between 2010 and 2012, but that consumption of infringing video streams rose by 470%".(Price, 2013)

Despite the vicissitudes of the change from cinema to digital, this path is irreversibly. The same happened with the television industry. Considered a mass media influence, in the transition to the digital, television was the protagonist of a long process with several modifications.

### 2.1.5 The Media Industry: Television

In the last decades of the XX century, television faced serious competition, first in the demultiplication of broadcasters, then with the advent of cable and finally with the Internet. In Portugal, between 1957 and 1968, there was only a single television channel that belonged to the State (RTP). After 1968, the second channel of RTP opened. Only on 1992, after a public tender for frequency allocation of emissions, were the first private television channels created: in 1992 SIC and then, in 1993, TVI.

According to Francisco Rui Cádima

> "The more pronounced crisis in the Portuguese public audiovisual begins in the end of the eighties, with what we then called the "preparation" of the State monopoly for the era of competition, since it remissed the entry of commercial operators on the Portuguese market at the beginning of the 1990s. (...) were then made, at that time, significant and disproportionate investments, especially on foreign program markets, to allow RTP to maintain a position of clear upward over those who would come to be the first private television operators in Portugal - SIC (which emitted for the first time to 6 October 1992) and TVI (20 February 1993)".(Cádima, 2002)[9]

On the other hand, while Europe and the rest of the western world knew from very early the freedom of expression, in Portugal the two TV State channels were controlled by censorship until 25 April 1974. Only 20 years later, the real freedom of access to the means of communication on television was accomplished, with the allocation of frequencies to private

9 Translation from the original reference "a crise mais pronunciada do audiovisual público português começa ainda no final dos anos 80, com aquilo que então se chamou a «preparação» do monopólio do Estado para a era da concorrência, dado que se avizinhava a entrada de operadores comerciais no mercado português logo no início dos anos 90. (...) Foram então feitos, nessa altura, significativos e desproporcionados investimentos, sobretudo nos mercados estrangeiros de programas, de forma a permitir à RTP manter uma posição de claro ascendente sobre aqueles que viriam a ser os primeiros operadores de televisão privada em Portugal – a SIC (que emitia pela primeira vez a 6 de Outubro de 1992) e a TVI (a 20 de Fevereiro de 1993)".

companies. Therefore, it can be considered that the experiences of domestic television were late, when compared with our European counterparts.

Cádima emphasizes that (with reference to the tv in the epoch of censure)

> "The size of the organization machine of tecnodiscursive ceremonial broadcasting, to the time of Salazar and Caetano, was structured and oriented in a juridical-administrative model that had as its fundamental strategy the subordination of the world of life to the imperatives of the political system practically created and, finally, the subordination and repression of virtue and civil social experience to the political system-televisual autocratic - as a means for its perpetuation and for its self-celebration". (Cádima, 2004)[10]

The television offer increased in 1994 with the cable television service. In July of that year 30 channels were transmitted in Portugal. In 1998 the first encrypted channels were included in the packages of TV access. With the Digital Satellite Service (system which dispenses the transmission by cable) places not covered by cable had access to satellite channels. I.e. this service uses a small satellite plate and a digital receiver for the transmission of the channels that were part of the cable television service. In November 1999, the navigation was faster, as it began to recourse to the fiber optic cable TV transmission. 2001 marked the entry, in an experimental period, of the digital interactive television, by the interactive cable TV – a company belonging to the holding "TV Cabo Portugal" at the time. "In June 2001, TV Cabo has become one of the first operators in the world to launch a digital television service and interactive, having been the first in the world to offer the functionality of digital video recording in a set-top box by cable with bi-directionality, based on the Microsoft platform TV Advanced".

10 Translation from the original reference: "a dimensão tecnodiscursiva da máquina de organização protocolar televisiva, ao tempo de Salazar e Caetano, foi estruturada e orientada segundo um modelo jurídico-administrativo que tinha como estratégia fundamental a subordinação do mundo da vida aos imperativos do sistema político monopartidário e, enfim, a subordinação e repressão da virtude civil e da experiência social ao sistema político-televisivo autocrático - como meio para a sua perpetuação e para a sua auto-celebração".

(Quico, 2004)[11]

With the progressive dissemination of bandwidths that allow the transmission of video and audio through the Internet, several projects of web tv (i.e. tv service via the Internet) have emerged in the whole country. In 2005 appears in the Azores the first webtv project - TVNET. In December 2006, the project extends to mainland Portugal. The TVNET was distinguished by its generalist nature, unlike other webtvs that focus on specific themes, such as entertainment, the scientific community, companies, or advertising.

"Historically, in Portugal, we can go back to the end of the year 2005, to find the first projects for Web TV in that context. The first of them being the draft for TVNET, which started at the end of 2005, curiously in Açores. About a year later, its directors launched the project in the mainland Portugal, being "on air" from its headquarters in Lisbon precisely since 11 December 2006." (Cádima, 2008)[12]

Despite the opportunity given to content, which are rarely focused on mass media, webtv's have chronic deficiencies arising from the absence of significant investments and consequent low-skilled labor: among these, the frequency of turned off services, the absence of information updates, as well as certain ethical issues in the copy of audiovisuals, and further a lack of professionalism or maturity. However, the webtvs seem to have proliferated at an institutional level, but also at a local and regional levels, despite their unexistent or near to none influence, which we must not fail to pay attention.

As stated by the researcher Francisco Rui Cádima "What is expected of the new media

11 Translation from the original reference "Em Junho de 2001, a TV Cabo tornou-se um dos primeiros operadores no mundo a lançar um serviço de televisão digital e interactiva, tendo sido o primeiro a nível mundial a oferecer a funcionalidade de gravação de vídeo digital numa set-top box por cabo com bi-direccionalidade, com base na plataforma Microsoft TV Advanced"

12 Translation from the original reference "Historicamente, em Portugal, podemos recuar ao final do ano de 2005, de forma a localizarmos os primeiros projectos de Web TV nesse contexto. O primeiro deles, aliás, terá sido o projecto TVNET, que arrancou no final de 2005, curiosamente nos Açores. Cerca de um ano depois, os seus responsáveis lançaram o projecto no conti- nente, estando "no ar" a partir da sua sede em Lisboa precisamente desde o dia 11 de Dezembro de 2006."

such as the Web TVs arising will be to build a model of communication that comes to be the backbone for consolidation of a new draft of the democratic experience, where the collaborative and participatory factors can bring the sphere of citizenship to the dignity of the political field, in a new context, essentially " deliberative" (Cádima, 2008)[13].

However these (r)evolutions should continue to be tracked to better understand the transitions, changes and transformations of the different devices to digital.

### 2.1.6 Publishing Industry

"A new technological leap has allowed the spread of the internet between the society in general: the draft of a new application, the World Wide Web, organizing the contents of the Internet pages of information, instead of by the location, which allowed users to a system for easy search the desired information" (Castells, 1996: 432)[14]

The words, or better, the thought of Castells refers a "technological leap", in the transition from the analogue models to the digital models. This transition has started one of the most outstanding revolutions in the publishing industry. The T.I.C. - Information and Communication Technologies - propose increasingly more sophisticated reading supports, which, apparently, could question the survival of the book itself.

Nevertheless, this is the exception that proves the rule, as in the publishing industry the book and the digital coexist without questioning each other. The reading devices coexist but do

13 Translation from the original reference “aquilo que se espera dos novos media como as Web TV emergentes será a construção de um modelo de comunicação que se venha a configurar como estruturante na consolidação de um novo projecto da experiência democrática, onde os factores colaborativo e participativo possam reconduzir a esfera da cidadania à dignidade do campo político, num novo contexto, essencialmente “deliberativo””

14 Translation from the original reference “Um novo salto tecnológico permitiu a difusão da internet entre a sociedade em geral: o projecto de uma nova aplicação, a World Wide Web, organizando o conteúdo das páginas da internet por informação, em vez de pela localização, o que possibilitou aos utilizadores um sistema de procura fácil da informação desejada”.

not replace the printed book. Moreover in this, as in all other cases, coexistence is the rule.

Brian Caulfield says that “the ability to grab free books online points to the device’s real competition: not paper books but Internet-friendly laptops, tablet computers and smart phones. The amount of content available online is growing fast, and devices for accessing the Net are getting better and cheaper quickly.” (Caufield, 2007)

The weakest link on the digital reading devices is their lack of flexibility, they are not easy to carry and do not allow the same ergonomics as paper. I.e., the screens continue to be stiff, relatively heavy and with remarkable energy consumption. In addition to these factors, the price continues to be a factor of inhibition: values range almost always by the hundreds of euros to have a device that does not really rival with the paper.

Jeff Bezos stresses that "it's so ambitious to take something as highly evolved as the book and improve on it. And maybe even change the way people read." (Bezos, 2007)

The exploration of this new type of device must combine what is best in physical books with what could be the possible gains using a device "If you're going to do something like this, you have to be as good as the book in a lot of respects, but we also have to look for things that ordinary books can't do." (Levy, 2007).

But irrespective of this factor, the truth is that all the publishing industry rehearses models of electronic books and attempts for new digital marketing strategies: Amazon deserves a special mention as the leader in sales in both analog and digital worlds. The Amazon was founded in 1995 by Jeffrey Bezos in Seattle. After 30 years as an executive on Wall Street, Bezos outlined a business plan for what would be the Amazon.com. At the beginning, Bezos wanted to sell 20 different products. However, at the release date of his company, Bezos decided it would sell, in an initial stage, only books. The reasons focused on the high demand from the market; the low prices of sale; and the high number of titles available in the printed version, ready to be distributed.

Later, with an unlimited capacity for the sale of books, the Amazon has become recognized by the sale of electronic commerce in all kinds of goods: in 2000, Bezos foresaw to reach billion of dollars in sales, but in 1999 it had already reached the 1.6 billions.

Many are the publishers who try to invade the privileged space occupied by the Amazon. The Book Depository, for example, was founded in 2004 by a former employee of the Amazon, Andrew Crawford, in the United Kingdom. With the motto "make accessible all books for all people", it offers a large number of books in the public domain for free download. It quickly became the largest online bookstore of the United Kingdom with international scope. However, the rivalry with the Amazon ended in July 2011 when the Book Depository was bought by Jeffrey Bezos, thereby integrating the sales network of the Amazon.[15]

The success of online shopping popularized and transformed the Amazon in one of the biggest sellers of the most varied selection of articles: from books, to toys, clothes, and even construction materials. With the acquisition of Mobipocket, a software company for e-books, the Amazon has integrated, in 2005, the sale of e-books. The sales success has exceeded the expectations: in 5 years sales of e-books were higher than the sales of physical books - for 100 physical books, 143 e-books were sold.

With the increase in demand, the Amazon has created a device to read their e-book – the Kindle. Up to now, the device has known various versions. The first edition was marketed in 2007: it had the format of a small tablet and allowed a reading of good quality, black and white, both books and newspapers, with the ability to make personal notes. To its disadvantage were the weight and the stiffness, you could not fold it in your pocket, besides its prohibitive price, even on the United States. And in this last aspect is one of the obstacles of the Kindle today: due to the high price, it is constantly being overtaken by their opponents - Apple IPad and the graphic tablets Android. With a strategic amendment on the online market - reduction of prices

[15] "Founded in 2004 to make 'all books available to all' we focus on selling 'less of more' rather than 'more of less' (differentiating ourselves from other retailers who increasingly focus on best-sellers" information retrieved from the website of the book the depository in http://www.bookdepository.co.uk

of e-books readers, making them more accessible to all - the Amazon has increased and created more variety in its own production of e-books. [16]

In 2011 the expectation on the sale of e-books was high “This new process of publishing is the way things are headed. It gives more creative control to the producers and writers of the books, which is good in most instances. It also pre-filters the success/failure rate”. (Dvorak, 2011)

The digital books allow innovative opportunities to the reader: the ability to aggregate content, referring the reader to more in-depth layers of knowledge; to search, annotate and share becomes a quicker and simplified process; and the portability of several titles in a single device.

Brian Haberlin, author of physical and digital books, in an interview to Josh Catone, stresses that there is a relation between the two types of publication, "I love print, always will. I love digital, always will. But they will continue to be different experiences. It’s a different texture, a different experience and that alone warrants their existence." (Catone, 2013)

Nonetheless, it does not mean that real books override the digital books or reciprocally: the coexistence provides the publishing industry more considerable profit margins.

In this sense, Josh Catone says that “e-books and print books could have a bright future together, because for all the great things e-books accomplish — convenience, selection, portability, multimedia — there are still some fundamental qualities they will simply never possess”. (Catone, 2013)

[16] Retrieved from http://www.amazon.com.

### 2.1.7 Evolution of Educational Technology

In the context of the systematic review on the foundations of the digital revolution, the evolution of educational technology is an essential point of analysis, even more as this is the point from which the objects and objectives of this thesis were drawn. Thus it is important to understand their characteristics and implications in the education system.

One of the characteristics of the educational system throughout the 20st century and in the first years of the 21st century is the centered teaching on the professor. The figure of the teacher presents as someone who controls the classroom. This model has remained identical to itself during the whole of the 19st century and in the first decades of the 20st century revealing an apparent immobility.

The contemporary society has a set of requirements that in certain cases are very far beyond the traditional educational strategies. With regard to this, Roberto Carneiro says that only the active subjects of the “educationally and scientifically more advanced nations will be trained to trigger complex challenges."(Carneiro, 2001)[17].

Similar expectations of amendment to the teaching-learning model happened with the TV and its introduction in education. This technological innovation was the fruit of many speculations about its transformative power inside school systems. In a country with few resources, the idea of having in the television a new vehicle capable of promoting learning was a disruptive factor. In 1965 the teleschool started its diffusion through the studios of Radiotelevisão Portuguesa, in Porto. It was a model of education through the TV that lasted until June 2003. The contents of the different disciplines of the 5th and 6th year of schooling were presented during a period of 15 minutes. During the remaining time of the classroom, the teacher who accompanied the class, provided students with worksheets and other texts of support. This model was important and essential to the rural areas where the building of

17 Translation from the original reference: “nações educacionalmente e cientificamente mais avançadas estarão capacitados para desencadear desafios complexos.”

schools or student transport to other zones was much more expensive. “It is certain that the Teleschool was not a system of pure distance training, as the students had to be in the same physical space and at predefined times and had a tutor who accompanied the classroom in person, but was a case of successful application of the television to education”. (Cação e Dias, 2003)[18]

With the advent of the digital, the general crisis in the education system was early evidenced, and the flaws were soon to emerge. Nevertheless, a large part of the school system remained indifferent, identical to itself, at least in appearance. Such indifference is justified by the obduracy to consider that the system responded with the possible effectiveness to social needs by the established powers, but also because the public opinion in general, continued to consider that the school system ensured the essential needs of production and its agents. “The educational sector was the one that most reflected the changes in social, cultural and economic landscape. By their high sensitivity to the winds of history, education was radiating all shifts within the Portuguese society, in its most difficult periods, but also all the ideals that were being awakened”. (Carneiro, 2000)[19]

At the beginning of the 21st century, Roberto Carneiro pointed to “a radical change in this static understanding of education. There is a revolution operating in the mentality of the people and in the culture of the organizations” (Carneiro, 2000)[20]. This revolution in the people’s mentality is also analyzed by researchers Barber, Donnelly and Rizvi (2013) which reflect on the trends in education today “the trend in the academy towards specialisation, which is at least a century old, continues unabated, but citizens of the world now cry out for synthesis”.

18 Translation from the original reference “É certo que a Telescola não foi um sistema de formação a distância puro, já que os alunos tinham de estar no mesmo espaço físico e a horas predefinidas e dispunham de um tutor que acompanhava a aula presencialmente, mas foi um caso de sucesso da aplicação da televisão à educação”.

19 Translation from the original reference “O sector educativo foi um dos que mais refletiu as transformações sociais, culturais e económicas. Pela sua elevada sensibilidade aos ventos da história, a educação foi espelhando todos os desnortes da sociedade portuguesa, nos seus períodos mais difíceis, mas igualmente traduziu todos os ideais que nela foram sendo despertados”.

20 Translationf from the original reference “uma radical modificação neste entendimento estático da educação. Há uma revolução a operar na mentalidade das pessoas e na cultura das organizações”.

The profound social crisis in the beginning of the second decade of the 21st century, particularly with youth unemployment, the level of undergraduate courses that evolves asymmetricaly quickly in the United States, in Europe and throughout the world, demonstrates that the educational system is giving clear signs of fatigue and that the stress of change is already part of the school systems daily life on the most advanced countries. “The price charged to students, even once the cost base is accounted for, is not always responsive to the classic relationship of supply and demand. Indeed, thanks to the inadequacy of outcome measures for universities (unlike schools, for example), input measures tend to be seen as proxies for quality. Hence in the various university rankings, the lower the student: teacher ratio, the better the ranking.” (Barber, Donnely & Rizvi, 2013)

The researchers also report that the challenge lies in the relationship between the cost of higher education training, the real value of the courses on the market and the surrounding economic changes in the process: “given the rising cost of degrees, the threat to the market value of degrees and the sheer scale of both economic change and unemployment, this is a vital and immediate challenge”. (idem)

This challenge requires changes and developments in the educational context. A progressive but consistent change in education systems is being set up and the increasing use of digital devices especially by the student body makes, in some way, irreversible their adoption by the various actors, in particular the teachers, especially the younger ones.

### 2.1.8 Trends in Higher Education

The panorama of higher education has been the scene of various changes. And the endeavor to understand the trends that emerge is a structuring element of this thesis.

To accomplish this, we decided to elaborate a descriptive analysis, necessarily brief, in

order to show that in the higher education system the digital learning, in the institutional dimension, came mainly through e-learning platforms.

A brief diachronic summary communally reveals that in 1997, Michael Chasen and Matt Pittinsky, created the company Blackboard Inc and an education management system softwares - Blackboard Learning System.[21] The aim was to equip the higher education system with a software for course material management, for the creation of online communities on the university campus and for student evaluation. It is both a virtual learning environment and a management system. This system, based on a web server, allows the course management with a customizable information architecture and the interaction with the students information systems. Can be installed on local servers or staying in the solutions offered by the company Blackboard Inc. "Blackboard is used by more than 70 percent of the U.S. colleges and universities named to the Forbes.com Most Connected Campuses' List. As of June 2006, the Blackboard empire includes over 12 million users in over 60 countries. Products are offered in 12 languages to over 2,200 learning institutions and contain more than 2,500 supplements from educational publishers" (Bradford et al, 2007)

With an identical assumption to the Blackboard, but based in the Open Source movement, in November 2001, was launched by Michael Dougiamas, the Moodle - Modular Dynamic Learning Environment - platform, which quickly gained notoriety and a larger number of users, given that has similar functionality to the blackboard and is free. "The acronym MOODLE stands for Modular Object-Oriented Dynamic Learning Environment. Among its many users, however, Moodle has already become a term of its own synonymous with a software package designed to help educators create quality online instruction. It was the brainchild of Martin Dougiamas, a former WebCT administrator with postgraduate degrees in Computer Science and Education". (Brandl, 2005)

[21] Bradford et al stresses that "Blackboard LLC was founded in 1997 by two education advisors, Matthew Pittinsky and Michael Chasen, a consulting firm to provide technical standard is online learning applications. Blackboard LLC was contracted to the IMS Global Learning Consortium, the worldwide non-profit organization within the National Learning Infrastructure Initiative of Educause". (Bradford et al, 2007)

The Moodle was built based on the constructivists and socio-constructivist models and enables teachers to create online courses. The development of Moodle continues to be a project of free software supported graciously both by a team of programmers and by the community of users of the platform. This community encourages debate and invites the users to give their views on the platform. With a growing evolution in the various countries, and with more than 83 thousand active sites, the platform moodle is an agnostic container, and effective, both in the administrative level, as the educational level and teaching materials. This is a system in continuous evolution that allows the user to interact and create collaborative content. Schools in more than 230 countries use Moodle and a cohort of programers scattered throughout the world cooperate for continued improvements on the platform. The Moodle uses local servers to save the content, however, there is a growing trend in transferring the content, formerly stored in servers, to the cloud[22], I.e. it the access becomes simpler and faster and, on the other hand, the costs, which involve the maintenance of a server, go down considerably. Like so, the contents are available in the cloud, and are not, in this way, subject to space issues/storage problems or technical failures of local servers.

> "Cloud storage system is a cooperation storage service system with multiple devices, many application domains, and many service forms. The development of cloud storage system is benefit from the broadband network, Web 2.0, storage virtualization, storage network, application storage integrated with servers and storage devices, cluster technology, grid computing, distributed file system, content delivery network, peer-to-peer, data compression, data encryption, etc." (Abu-Libdeh et al, 2009)

With the developments and mutations in the field of e-learning, at a national level, various were the forms of approach to e-learning systems: the Research Center where I have been researching for over 9 years, - C.I.T.I. - developed and put into operation, in the years 2000-2001, an online platform for education - the *Rede de Centros de Recursos em*

22 The concept of cloud storage (in English, cloud storage) refers to the use of memory and storage capacity of computers and shared servers and interconnected on the Internet.

*Conhecimento.* It was an order of INOFOR - National Institute of Professional Training, currently extinguished. The platform's goal was to connect online a set of thirty vocational training centers, scattered from the North to the South of Portugal. Each center had a collection of digital means, which the platform interactively connected between the thirty units, with a bandwidth of about 150 Kbits/s. The resources included in each one of the centers and in its central node, in Inofor, were relatively important: a central library with books in their full digital version, movies, support material to lessons, as well as e-mail, a dashboard and an exclusive social network. The project was distinguished by Microsoft in its VII software competition with an honorable mention.

It is important to share, in this context, that the issues related with the bandwidth available in the trade channel were - and to some extent still constitute - in many regions of the world an insurmountable obstacle to the effectiveness of the e-learning platform. For example, students of the Master in Management of E-learning Systems that are in Africa, in the region of Lubango, access in very small bandwidths and with frequent failures of electricity. With this lacking, of course, the entire computer system collapses. To overcome these adversities another important branch of e-elarning was used - the E.A.C. (computer-assisted education) [23], which does not depend on the Internet: programs specifically designed for teaching / learning on the computer are installed for each student, who is invited to work on specific competences. It was in this context that C.I.T.I. created one of its lines of research: the e-Tutor program: a request for the Ministry of Justice for judges use. It was a project developed to promote, in 2001, the self-training through the interaction between a virtual agent and the user. The virtual agent - or avatar - of his name Togas interacted with the user through instant feedback to each user action in the different learning modules. The program was divided into modules and sub-modules where Togas - a retired judge, with the role of system tutor - or the Betty Bit - specialist in word processing, formulas and spreadsheets - mediated the user learning. The

[23] The researcher Lúcia Amante describes the computer-assisted education "EAC is reflected in a current version of programs called drill and practice) intended for the training of specific competences and that, although much discussed, unanswered longer still to be used (Crook, 1998). This approach is essentially based on traditional behaviorist theory, conceives the learning task as a result of repeated certain tasks designed in a given level of difficulty adjusted their competences of subject, previously evaluated (Hughes, 1990)" (Amante, 2011)

objective was the acquisition of competences in the area of Microsoft programs such as Excel, Word or Outlook. The virtual agent helped the user to learn or recycle knowledge through exercises and the revision of the subject in each module of learning.

The computer-based learning was the chosen strategy to overcome the greatest obstacle of the target public of this project: a class of professionals who feel the need to receive specific training in the area of digital literacy, but who however do not assume this need due to the top position/status they occupy in the professional system hierarchy. In this sense, the use of a graphical interface multimedia allied to the creation of a digital mentoring program was the solution found. They had the opportunity to learn when and where they wanted and at their own pace. Several courses were created in an offline learning model and using the CD-ROM support.

In 2002, the e-Tutor project was distinguished in V National Competition of Microsoft software with the 1st Universities Prize by the research developed in the first CD-ROMs with courses: e-tutor of electronic mail and e-tutor of Internet Access.

The dynamic of the platforms and e-learning systems can be analyzed through strategies of implementation. This is the case, for example, of the Khan Academy translated to Portuguese by the Portugal Telecom Foundation. It began as a set of explanations of mathematics, of free access, on matters of the 1st to 12th year of schooling. Also on YouTube, there are dozens of channels with explanations on various matters. Any person, whether a student, a teacher or an educator, can access the contents and use them in the best way that suits them.

> "Khan Academy is an educational website that, as its tagline puts it, aims to let anyone "learn almost anything – for free." Students, or anyone interested enough to surf by, can watch some 2,400 videos in which the site's founder, Salman Khan, chattily discusses principles of math, science, and economics. The videos are decidedly lo-fi, even crude: Generally seven to 14 minutes long, they consist of a voice-over by Khan describing a mathematical concept or explaining how to solve a problem while his hand-scribbled formulas and diagrams appear onscreen."

(Thompson, 2011)

The story is rather curious. Salmon Khan began with explanations of mathematics made in video to his cousin that was in New Orleans. Bill Gates used the same videos to improve his son's learning. The success motivated him to offer financial support for the Khan Academy. In an interview to CBS, Salmon Khan says that

> "I got a call from Larry Cohen who is Bill Gates' chief of staff. And he says, you know, "You might have heard Bill's a fan." And I'm like shaking. I'm like, "Yeah, I heard." You know. And he was like, "If you have time, you know, love to fly you up to Seattle." And then I was looking at my calendar right then for the month. Completely blank. And I was like, "Yeah, you know, I think I could, you know, fly in, you know, between like laundry and a bath and meet with Bill." (Khan, 2012)

With the maximum "changing education is the better by providing the free world-class education to anyone anywhere" and 15 million dollars of financing from the Gates Foundation and Google - Khan "has been able to hire with competitive salaries some the most talented engineers and designers in the country. The Khan Academy office sah the intense vibe of the Silicon Valley startup. The team is working to create software they hope will transform how math is taught in American classrooms." (CBS, 2012)[24]

According to Salman Khan

> "our goal is to use technology to humanize, not just in Los Altos, but on a global scale, what's happening in education. And actually, that kind of brings an interesting point. A lot of the effort in humanizing the classroom is focused on student-to-teacher ratios. In our mind, the relevant metric is student-to-valuable-human-time- with-the-teacher ratio. So in a traditional model, most of the teacher's time is spent doing lectures and grading and whatnot. Maybe five percent of their time is actually sitting next to students and actually working with them. Now 100

[24] Interview the Salmon Khan by CBSNews for the program 60 minutes.

> percent of their time is. So once again, using technology, not just flipping the classroom, you're humanizing the classroom, I'd argue, by a factor of five or 10." (Khan, 2011)

On the other hand, a new strategy of e-learning in analysis is present in some publishers who exploit the market. Currently the editorial market explores the sale of books in the traditional form and aggregates also the additional explanations to their manuals. It is the case of Porto Editora that in their Virtual School project allows access to registered users to the supplementary digital materials: this is the case of paid explanations and complementary courses, for example. There is also a different type of supplementary materials made available by the publisher, however, to analyze them it would be necessary to purchase the printed manual.

The coexistence of two different models - the free and paid - is not yet stabilized. The growth of the digital offer questions the business model of the publishing industry: the quality of free access content rivals with paid content conditioned by the publishers.

One of the possibilities to overcome this false dynamic is through the development of strategic alliances between institutions in the same sector of activity, i.e., in this case, a cooperation and competition between publishers. We speak of coopetion, in this sense, as a simultaneous relationship between cooperation and competition – as an institution or a person - as a means of speeding up progress and innovation in the publishing industry sector.

The journalism, a very specific case within the publishing industry, is also in the path to change their business model to survive to the national and international market contingencies. In the words of Thomas Baekdal "We are moving from a disconnected world, based on one-way physical distribution channels, to a new world where people are socially connected, centered around a digital lifestyle". (Baekdal, 2011)

The digital space has changed the business model, the competition is the connection

between the individuals and companies and the emergence of new business models to cope the contingencies of the publishing industry. In the context of digital content, Baekdal refers that "if you want to sell digital content online, you have to do it in a way the Internet works best. The internet is about the link, the act of sharing, the social engagement, the feeling of being a part of something, the feeling that you can show this to your friends, and the feeling of you are getting smarter because of it." (Baekdal, 2011)

In the words of Mark Johnson, Clayton M. Christensen and Henning Kagermann companies seeking to achieve success need to reinvent their business models, thus they advise an analysis to the existing business model

> "the first is to realize that success starts by not thinking about business models at all. It starts with thinking about the opportunity to satisfy a real customer who needs a job done. The second step is to construct a blueprint laying out how your company will fulfill that need at a profit. (...) The third is to compare that model to your existing model to see how much you'd have to change it to capture the opportunity. Once you do, you will know if you can use your existing model and organization or need to separate out a new unit to execute a new model." (Johnson et al, 2008)

We consider to be relevant to mention the topic of disruptive innovation of Joseph Schumpeter (1939), the author considered innovation as the creator and destructor of businesses and industries. The researcher also examined, the disruptive nature of the technological change that can generate waves of creative destruction.

This issue is mentioned as we considered it to be in the center of the changes made in the course of the educational systems, public and private. Thus:

> "many policymakers recognize the benefits of online learning and want to see it used to serve students. But online learning still needs time to prove its value to the public before it can become a mainstream option that students, parents, and

> school leaders naturally seek to leverage for core academic instruction (...) In order to help online learning grow and develop, policymakers should create circumstances where online learning and traditional schools have asymmetric motivation. ” (Arnett, 2014)

Already in 2002, Clayton Christensen when studying disruptive innovations[25] considered that: "companies seeking to create disruptive growth should search for ways to compete against non-consumption: people's inability to use available products and services because they are too expensive or too complicated. It's much easier to target potential consumers who aren't buying at all than to steal customers from an entrenched competitor”. (Christensen, et al., 2002)

In this sense, it is considered that “the true importance of disruptive technology in Utterback’s (1994) and in Christensen's (1997) conception of it is not that it may displace established products. Rather, it is a powerful means for enlarging and broadening markets and providing new functionality”(Utterback et al, 2003)

The concept of innovation disruption can be analyzed in education. To Thomas Arnet, disruptive innovation is based on asymmetric motivation “the differences in how incumbents and disruptors view opportunities to serve new or less-demanding customers is called asymmetric motivation. In short, asymmetric motivation is what allows a disruptive innovation to fly under the radar of the established players in a sector until the transformation of that sector is all but inevitable” (Arnett, 2014)

In the framework of the educational systems, the teaching models now admit the coexistence of classroom courses and online platforms.

25 The theory of disruptive innovations was coined by Clayton M. Christensen, Harvard professor in his research on the industry of disk drives and was best known through his book The Innovator magazine's Dilemma, published in 1997.

#### 2.1.8.1 b-Learning e Flipped Learning

Among the strategies adopted in the context of higher education, it is important to highlight the initiatives of b-learning and flipped learning.

The b-learning is characterized by the fusion and use of two forms of teaching: classroom and virtual. The word b-learning refers the dual nature of this mode of teaching. The letter "b" has in itself the blended significance, i.e., mixing, fusion of two methods.

The students have a component of classroom classes, with a schedule their curricular units that must meet, and have available a few lessons in the online system.

The role of the teacher is molded in the context of the virtual learning, in the words of Lévy "The teacher becomes an animator of collective intelligence of the groups that instructs. His activity will focus in the monitoring and management of learning: incitement to an exchange of knowledge (...) and the piloting of custom tracks of learning etc." (Lévy, 1997: 184)[26]

In the case of the blended learning, it is a model of joint training, which in turn is a model with its own characteristics that covers the best components of teaching at a distance and in the classroom (Lencastre & Chaves, 2006).

The b-learning can be defined as a form of knowledge distribution that is part online training and also uses the classroom with a group of students gathered in a classroom with a teacher (Gonçalves, 2006).

The b-learning allows you to combine the flexibility and the pace of individual knowledge acquisition, i.e. provides live moments in the classroom, for reflections in group, as well as it regards the ideal moment for each individual to learn (Lencastre & Chaves 2006).

26 Translation from the original reference "O docente torna-se um animador da inteligência colectiva dos grupos de que se encarrega. A sua actividade centrar-se-á no acompanhamento e na gestão das aprendizagens: a incitação à troca dos saberes (...) e a pilotagem personalizada dos trajectos da aprendizagem, etc."

Several research lines admit that the best solution will be the complementarity between the online and in person, i.e. an integrated process of learning that join the best of both strands (Gomes, 2006).

In 2008, Garrison and Vaughan stated that the future of higher education could be the b-learning

> "Blended learning is a coherent design approach that openly assesses and integrates the strengths of face-to-face and online learning to address worthwhile educational goals. When blended learning is well-understood and implemented, higher education will be transformed in a way not seen since the expansion of higher education in the late 1940s. The challenge now is to gain a deep understanding of the need, potential, and strategies of blended learning to approach the ideals of higher education"

Redecker (2008) tries to characterize some behavioral attitudes that students take from working in digital platforms,

> "digitally literate, they think more visually and in a nonlinear manner, they practice multitasking and give preference to multimedia environments. They are continuously connected with their peers and —always on. In learning environments they are easily bored, need a variety of stimuli not to get distracted, are impatient and expect instant feedback and rewarding. They are social, team - spirited and engaged, goal - oriented and pragmatic, and appropriate (learning) resources to suit their individual needs. To come to terms with the information overload of the digital era, they (need to) employ learning strategies that involve searching, sieving, managing, recombining, validating and contextualizing information. (Redecker, 2008:17)

The flipped learning, which in Brazilian Portuguese in Brazil was "baptized" with an original name - "ensino às avessas" – transforms the classroom in a space of learning and not only of mere instruction. This is a movement inspired by the work of Salman Khan, who

created a video library of free tutorials on different materials, known as the Kahn Academy (already mentioned in this thesis).

The term "flipping" gives the idea of changing the place for the typical homework from home to the classroom: “Students typically are assigned the video-watching for homework, freeing up class time that used to be spent listening to lectures for hands-on activities and application of knowledge, which used to serve as homework”. (Ash, 2012)

In accordance with Lage et al. (2000) we can define it as “inverting the classroom means that events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa” (p.32).

However this definition is not always the most accurate, since many researchers go far beyond this exchange of roles between the classroom environment and outside the classroom.

Several researchers, Lage et al., Foertsch et al, Demetry, Toto & Nguyen, Warter-Perez & Dong, Zappe et al., refer that many of the interactive learning activities based on groups of work in the classroom use the learner centered theories of learning based on the work of Piaget and Vygotsky.

It is however noted that the nature of these activities varies from study to study, and the concept of work from home or "homework" also varies. But despite these variations, we know that the concept flipped learning is much more used with activities of videos-asynchronous classroom and with exercises “The flipped classroom label is most often assigned to courses that use activities made up of asynchronous web-based video lectures and closed ended problems or quizzes. In many traditional courses, this represents all the instruction students ever get. Thus, the flipped classroom actually represents an expansion of the curriculum, rather than a mere re-arrangement of activities” (Bishop et al., 2013)

Thus, the authors consider ”we define the flipped classroom as an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom” (idem)

Important to refer that the discipline of Interactive Media, in collaboration with Professor Carlos Correia, has been putting in motion, since 6 years ago, a flipped learning system with widespread student satisfaction, assuming the anonymous evaluations that at the end of the course the Steering Board of the department of Communication Sciences sends us.

#### 2.1.8.2 Moocs

The diversification of e-learning strategies has as objective to find a system capable of serving the teaching/learning process. Since the beginning of the 20st century various were the attempts made. The MOOC - Massive Open Online Courses, as the name implies, are courses of divulgation and massive free participation. These caractheristics determined a very broad initial growth.

The MOOCs are online courses which aim at unlimited free access participation and to any interested party. In addition to traditional course materials, such as videos, complementary readings and exercises, the MOOCs provide outside users a *fora* that establishes a Community among students, teachers and tutors. The MOOCs have emerged as one of the features of Open Educational Resources (OER) - free online resources for educational purposes. The term MOOC was created in 2008 by Dave Cormier, University of Prince Edward Island and by the researcher Bryan Alexander, of the National Institute of Technology. The first course similar to this model was the CCK08 - Cognitivismo and Knowledge Connected – by George Siemens from the University of Athabasca and Stephen Downes of the National Research Council.

> “At the time, Cormier was web projects lead at the University of Prince Edward Island and had been helping out with the Connectivism course (he is now

> project lead for student relations at the institution). For him, the newly christened Mooc was interesting but not exceptional. “I didn’t really feel like it was much different from the other things we had experimented with,” he says. “I’ve been part of numerous groups of folks experimenting with what you can do with the internet and education for the past 10 years or so.” (Parr, 2013)

Dave Cormier (2013) explains the course was attended by 25 students of the University of Manitoba that paid tuition and 2200 students in the online version - the general public did not paid tuition. The course content was available via RSS feeds and the online students could participate through different collaboration tools.

Cormier (2013) stresses that the massive and comprehensive component of MOOC is the “potential to have people with vastly different perspectives. Particularly when you're talking internationally: having people from different cultures and different socioeconomic backgrounds.”

The researcher Irene Tomé adds that “the word "massive" immediately indicates that the ambition of scale is at the level of thousands, tens or even hundreds of thousands. And this will certainly be the biggest news in digital learning so far confined to the range of tens or hundreds of students enrolled. It was in fact the scale that aroused the attention of the media (Simonite, 2013)” (Tomé, 2013)[27]

The authors Summer, Barber, Donnelly and Rizvi (2013) refer that: “Massive Open Online Courses (MOOCs) can take the best instructors global. Choosing among these resources and combining them as appropriate, many of those served by traditional universities may be able to better serve their objectives”.

In an interview to Chris Parr, George Siemens states that in the construction of Mooc

27 Translation form the original reference “a palavra “massiva” desde logo indica que ambição da escala se situa a nível dos milhares, dezenas ou mesmo centenas de milhares. E esta será certamente a novidade maior nas aprendizagens digitais até agora confinadas à escala das dezenas ou centenas de alunos inscritos. Foi aliás a escala que suscitou a atenção dos meios de comunicação”

“Our goal was to encourage the development of learners through open and transparent learning, where the process of knowledge generation was iterative – improving on the ideas of other learners and generating new knowledge through continual improvement” (Parr, 2013)

Several are the institutions that develop courses to integrate in MOOC, whether in the United States or in Europe. In a brief historical digression is important to mention some dates that delimit and characterize the evolution of MOOC. In October 2002 the first intention of collaboration and construction material for the creation of *online content* is consolidated between the OpenCourseware (OCW) and the Massachusetts Institute of Technology (MIT). “A year after MIT's decision (about OCW), Unesco held a forum on open courseware for higher education, which led to the use of the term "open educational resources". Soon, other universities leapt on the bandwagon. The global OpenCourseWare Consortium, a group dedicated to advancing educational content, now counts more than 200 higher education institutions around the world as members” (Attwood, 2009)

Later, in September 2006, Salman Khan creates the Khan foundation. For Laura Pappano (2012), the Khan Foundation has deeply contributed to the form of content presentation at the MOOC, “the medium is still the lecture. Thanks to Khan Academy’s free archive of snappy instructional videos, MOOC makers have gotten the memo on the benefit of brevity: 8 to 12 minutes is typical. Then — this is key — videos pause perhaps twice for a quiz to make sure you understand the material or, in computer programming, to let you write code. Feedback is electronic. Teaching assistants may monitor discussion boards. There may be homework and a final exam.”

In January 2009 the first virtual university is founded - University of People. According to data from 2011, “UoPeople has attracted more than 1000 students from around the globe, some of them even studying in the tent villages on Haiti or in refugee camps in Sudan.” (Winkler, 2011)

In August 2010, Bill Gates supported financially the Khan Academy, and in September of

the same year, Google has assigned a donation of 2 million dollars to Khan Academy, through the program *Project 10 to the 100*.

> "Beyond admirers like Milner, Khan's meteoric success has attracted the financial support of a bevy of high-profile, socially minded backers, including Ann Doerr, the wife of billionaire venture capitalist John Doerr; Bill Gates; Netflix CEO Reed Hastings; NewSchools Venture Fund, whose CEO is the former president of the California State Board of Education; and Google, whose chairman, Eric Schmidt, serves on the academy's board. In total Khan has raised $16.5 million, with assurances of more to come." (Noer, 2012)

In October 2011, Peter Norvig, Google Inc. director of research has created, in partnership with Sebastian Thrun, the first MOOC on artificial intelligence. With more than 160 thousand students enrolled, from 190 countries, the free access course was a success. "We announced the class on July 29th, and within two weeks, 50,000 people had signed up for it. And that grew to 160,000 students from 209 countries. We were thrilled to have that kind of audience, and just a bit terrified that we hadn't finished preparing the class yet." (Norvig, 2012)

Peter Norvig adds that the construction of the course was made through different learning stages

> "From Daphne Koller and Andrew Ng, we learned the concept of "flipping" the classroom. Students watched the videos on their own, and then they come together to discuss them. From Eric Mazur, I learned about peer instruction, that peers can be the best teachers, because they're the ones that remember what it's like to not understand. Sebastian and I have forgotten some of that. Of course, we couldn't have a classroom discussion with tens of thousands of students, so we encouraged and nurtured these online forums." (idem, 2012)

In November 2011, an initiative of the Ivy Leage universities was announced - "The Floating University" - to promote their paid content through videos, with Hollywood style

productions. In fact, multimedia presentations are one of the main aspects of this university. “Floating University students don't have to drag themselves out of bed or race across a campus to do so. Instead, they go online whenever they want, and they get to watch engaging video lectures in which professors stand in a white, "Matrix"-style space accompanied by moving graphics, video clips and well-timed sound effects. Such videos let students rewind and absorb information at their leisure.” (Hsu, 2011)

In December 2011, the Massachusetts Institute of Technology (MIT) announces the creation of a free virtual and massive educational initiative - MITx

> “MITx will offer a portfolio of MIT courses through an online interactive learning platform that will: organize and present course material to enable students to learn at their own pace; feature interactivity, online laboratories and student-to-student communication; allow for the individual assessment of any student’s work and allow students who demonstrate their mastery of subjects to earn a certificate of completion awarded by MITx; operate on an open-source, scalable software infrastructure in order to make it continuously improving and readily available to other educational institutions.” (MIT News, 2011)

2012 was considered the year of MOOC, and was the result of several progressions in MOOC’s development at a world level. Despite that, in January 2012 Sebastian Thrun officially announces the Udacity - a platform in everything opposite to MOOC, as it offered the called Nano degrees - short duration courses for professional skills acquisition at relatively moderate prices to access from anywhere in the world. Charles West Ventures invested 5 million dollars in Udacity. In February, first Udacity courses are launched. In March, it is the turn of MITx to launch its first MOOC course. In April Coursera it’s advertised, created by Daphne Koller and Andrew Ng, as an investment from various universities - such as Princeton, Michigan and Pennsylvania – as a virtual education initiative to launch their first course. “Coursera makes heavy use of interactive, Web 2.0 tools in its massive open online courses, or MOOCs. That’s a sharp contrast with the “taped lecture” approach that had been a hallmark of earlier distance-learning efforts. Even though an individual MOOC may attract 100,000 or more students

worldwide, each course offers personalization on several levels, in a bid to keep students engaged.” (Anders, 2013)

In May MIT and Harvard announce the edX - an initiative of 60 million dollars with the goal of reaching 1,000 million students. “Online tools developed for edX will also supplement the lectures, seminars and labs available to MIT’s and Harvard’s own students, and will provide detailed data about how well different parts of lessons are understood and what areas may require further explanation.” (NI, 2012)

In July, the University of Berkeley joins the edX, and the Coursera announces the integration of 16 new universities to their initiative. In November, the Coursera had more than 1.9 million students. Andrew Ng denotes scale is a challenge in online courses, “standard online discussion forums are a fine way to bring communities together — for 100 or so users. “With 100,000 it gets more complicated,” he says. Hundreds of students might end up asking the same question. So the developers implemented a real-time search algorithm that would display related questions and potential answers before a student could finish typing.” (Waldrop, 2013)

Thinking of the development and application of MOOC in universities it is vital to refer the two types of existing organizations: the cMOOCs and xMOOCs.

The cMOOCs (C refers to "conectivist", the theory that inspired it) use the open source platforms and are used by teachers as an integral part of their academic and professional activities in universities, in this sense, are based on peer learning.

“Connectivist MOOCs (cMOOCs) are distributed in the sense that they do not run on a single website or with a centralized core of content; the content in cMOOCs is networked. Participants are encouraged to meet in locations of their choosing and organise themselves.” (Mackness, 2013)

The xMOOCs are online versions of the traditional learning in platforms with their own software. There is a contractual and commercial relationship between platforms and the Universities. The Universities create the contents and the technology to be used on the platforms. The three largest suppliers of platforms are edX, Udacity and Coursera.

"xMOOCs are convened on a designated platform; they may offer alternative sites such as Facebook or Twitter, but the course runs principally on the main platform, where interaction takes place in discussion forums. " (idem, 2013)

Yuan and Powell (2013) added to this definition and distinction that:

> «cMOOCs emphasise connected, collaborative learning and the courses are built around a group of like-minded individuals' platform to explore new pedagogies beyond traditional classroom settings and, as such, tend to exist on the radical fringe of HE. On the other hand, the instructional model (xMOOCs) is essentially an extension of the pedagogical models practised within the institutions themselves, which is arguably dominated by the "drill and grill" instructional methods with video presentations, short quizzes and testing».

| xMOOCs | | cMOOCs |
|---|---|---|
| Scalability of provision | **Massive** | Community and connections |
| Open access - Restricted license | **Open** | Open access & licence |
| Individual learning in single platform | **Online** | Networked learning across multiple platforms and services |
| Acquire a curriculum of knowledge & skills | **Course** | Develop shared practices, knowledge and understanding |

**Figure 1 – MOOC TYPOLOGIES**

We consider relevant to show the table above to summarize the differences between the typologies described. In figure 1 we can verify different typologies of MOOC within the concepts: massive, open, online and course. "The different interpretations placed upon the title

words have significant implications for developing business models, pedagogical opportunities and technology options for each type of MOOC."(Yuan at al, 2014)

#### 2.1.8.3 Nano Degrees

From the year of MOOC - in 2012, to the year of anti-MOO - in 2013, we can see the route from a euphoric state to an almost dysphoric state. In an interview, the vice president of strategic relations for academic partnerships in the United States, Akiba Covitz, refers that: "Universities especially state universities - are facing tremendous budget crunches. So are Harvard, MIT, everybody. How do we do this amazing thing and get our ideas out the world and not go bankrupt? This is the challenge." (Straumsheim, 2013)

Yuan, Powell and Olivier (2014) emphasized that the solution might be one of two options,

> "one way to realise the potential of MOOCs in higher education, is to develop an open learning model that enables 'pay as you go' approaches. To appeal to a wider set of learners, a choice from self and peer evaluation by the individual through to formal recognition of learning with paid-for accreditation and awards is one dimension that HEIs are exploring. Another is intensive tuition at a variable lower cost. Learners may chose only to access open learning materials available free of charge, or additionally opt from a paid-for continuum of support including lectures, tutorials and seminars, offered online or face-to-face by universities."

The complementarity of knowledges between the classroom and online learnings can provide a network of contacts for future work and the intersection of experiences, "as concepts and skills are taught more effectively online, it's unlikely that face-to-face interaction will cease to matter. Instead, students will be able to arrange for such experiences when it suits the job they need to get done. Given the reality that we all have different learning needs at

different times, that's a far more student-centered experience. It may not benefit some colleges but should create more options for all students." (Christensen e Horn, 2013)

The technology used in MOOC allied to creativity in their use may provide important tools to students, "to many children today, group videoconferencing comes naturally, as the virtual and the real are a continuum rather than a contrast. This technology, along with ubiquitous content and instant multiple channels of communication, will be able to deliver the experience of rich interactions in a classroom with one's peers regardless of location." (Barber et al, 2013)

The researchers Barber, Donnelly and Rivzi add that students "should seek out to learn and practice the skills associated with being innovative. They should seek to be on innovative teams, in innovative organisations and part of an innovative society as these are the places where they will grow and develop the skills needed to be globally competitive. "(Idem, 2013)

According to data from a University of Pennsylvania study the MOOCs are typically attended by medium-high yield people with completed academic degrees, contrary to what was initially thought. Even in developed countries, those who have not completed the university education did not show any interest in learning with the MOOC, even for free.

According to the research of the University of Pennsylvania "80 percent of MOOC students come from the wealthiest and most well educated 6 percent of the population", these students are looking to "recycle" their knowledges or to update knowledge in order to respond to a job demand.

In response to this need for innovation and "knowledge recycling" from students, Udacity is launched. Udacity was founded by Sebastian Thrun and supported by AT&T, North American Telecommunications Company. The company created the nano-degree courses with a contrary to MOOC purposes: the goal is to offer short courses at very reasonable prices. The creation of courses that allow to increase or create employability is one of the goals of the nano

degrees. On the other hand, they can also be useful for the “knowledge recycling” resolutions of those who work and just want to update knowledges for the labor requirements.

According to Sebastian Thrun, director of Udacity, the goal is to create different courses, which - as a whole - provide a multiplicity of capacities: the courses are worth by themselves but combined are stronger “By putting in half a year of work, less work that you put in for a regular degree, we can get you from one point to another. For instance, if you’re a skilled programmer, we can turn you into a mobile programmer, and for mobile programmers, there’s an endless number of open jobs right now. Or we can take you from programmer to data scientist.”(Thrun, n/d)

According to some authors, the relationship between the business environment and the universities can be the way to help overcome the economic crisis in which we live.

Sebastian Thrun refers that the economy in education has an importante role "things like tuition rates, bureaucracy, and job investments, are all colliding right now. And the level of education that you need to have for even the most basic job has gone up. For an educator to ride the wave, you have to embrace experimentation and openness towards technology.” (idem)

In spite of many controversies and according to a study by the University of Columbia, the relationship between the traditional MOOCs and the traditional academy will not be affected as many have indicated “we ourselves expect that MOOCs or their derivatives will continue to play a role in the continuing education of working professionals, in experimentation with various types of blended or hybrid delivery models on campus, and in efforts to help struggling students find low-risk options to build skills that allow them to test out of developmental education courses”. The study adds that those who answered to the study expect to see more innovations from MOOC: a more active and collaborative learning, inverted classes, and the use of other resources such as videos, games, sounds.

#### 2.1.8.4 Scenarios for the 21st century Education

The increased participation from higher education institutions on the various modalities of digital learning is a recurring topic in the agendas of policy makers and academics open for discussion. So much that, as a consequence, the Organization for Economic Co-operation and Development – OECD has developed the "University Futures". The goal of the project is to alert and explain the higher education institutions the existing mutations at the education level. They released the first volume of the series of books "Higher education by 2030", presented in 2008 at the conference "Higher Education to 2030: What Futures for Quality Access in the Era of Globalisation?" In accordance with the goals, it is intended that policy makers be informed of the recent changes, as well as of new trends, in higher education; to give them paths for strategic reflections on the main challenges in higher education; and also to create scenarios for the future - 15-20 years – so that all parties concerned have an informed perspective of the processes of evolution on the higher education system. In this first volume the OECD defined four possible scenarios for which the institutions can adapt to these contingencies. The scenarios do not refer to predictions about the future, but intended to create tools for reflection on the past, present and future strategies.

The first scenario "Open Networking" is characterized by internationalization and a contact network between the different institutions. It is a collaboration without being a competition in higher education system. The curricular units are chosen individually, i.e. each student can create or draw its academic path through the choice of curricular units, which empowers the student with a greater autonomy. The curricular units are mostly lectured online and in English in order to allow greater mobility. The aim of this scenario is to have free knowledge base or with very low costs, accessible to all – which is called "open knowledge". The increase of international collaborations to the network does not jeopardize the hierarchical structure of the institutions: the institutions of greater prestige manage to receive larger funds and consequently the network formed may show a trend in the choice of research partners. Recent developments like the Bologna process are seen as a starting point to develop this

scenario, as the Bologna process has harmonized the links between different institutions, allowing greater mobility for students.

The second scenario "Serving Local Communities" has the goal make teaching and research meet the needs of the local community or region. It is a scenario where ambitions of research and internationalisation are reduced. Thus, the academy's role is essentially dedicated to education and, only after, to research. The academics are professionals of great relevance in community decisions and control the education and research. The funding does not represent a problem, once they work directly with local industries to resolve their needs. The international relations between institutions are seen with skepticism due, for example, the recent events such as the terrorist attacks, wars or even due to growing immigration. This is an anti-globalisation movement based in economic, cultural and ideological views.

In the third scenario "New Public Management", the institutions are financed with public funding, however, for the supplement of its financial management they resort to private entities. The institutions are autonomous but they still need the State money for their budget. To increase the budget they look for other external funding options: the barrier between private institutions and public institutions becomes more tenuous since the financing, comes, in large part, from student fees and private foundations. The pressure between higher education institutions is exerted by budgets and the incentives of private entities.

In the fourth scenario "Higher Education Incorporated", higher education institutions provide services both to a commercial level, education, or research. The institutions are focused on their business model - teaching or research - liberalising the educational system. The driving force of this scenario lies in the investment to attract students: on one hand, institutions seek to respond to students needs, creating international programs and subsidiaries in different countries, to increase competition and become more attractive; on the other hand, the renowned and prestige institutions are still evaluated by their peers and are self-sufficient in their internal management, thus keeping its reputation. Research has a fundamental role in this, as the competition for obtaining financing for higher education institutions has been

increasing, and has been considered almost as a commercial service to be sold internationally, as with other goods. As such, for a greater internationalization, English is the language used for research and for postgraduate education. Nevertheless, despite the level of graduation, the language of each country has still predominance in higher education.

These scenarios are the mirrors of higher education institutions apprehensions at a world level. However, other possible solutions emerge in the context of the growing economic crisis and high cost of tuition. These budgetary contingencies propitiated the appearance of the MOOC courses that have its origins in the creation of free access content, without costs associated to the student. The individual design of the student curriculum is a motivating force: learners today want to build their own curriculum with the features they consider essential to the labor market. Also, as refered previously, this curriculum also covers those who are already in the labor market and want to "recycle their knowledge". The researchers Li Yuan, Stephen Powell and Bill Olivier (2014) refer that "the key opportunity for institutions is to take the concepts developed by the MOOC experiment to date and use them to improve the quality of their face-to-face and online provision, and to open up access to higher education. Most importantly, the understanding gained should be used to inform diversification strategies including the development of new business models and pedagogic approaches that take full advantage of digital technologies."

However, there is still no recognition of diplomas coming from MOOC courses, only some certificates, almost always issued by entities possessing the MiriadaX, Coursera platforms, among others.

Universities are facing new challenges: on one hand, the construction of this type of courses allows a greater dissemination and internationalisation of the institution, on the other hand, the use of audio-scripto-visual elements is not a common practice for academies. That is, the use of audio, video and text combined is not often used in the classroom. The way technology is used in the school environment is an object of reflection from researchers

> "MOOC developments are causing institutions to re-visit online distance learning and consider how they can better use technology to reduce costs, create efficiency in their teaching operations, demonstrate value, and reach new markets. Whether or not MOOCs become a part of mainstream provision, there is a question about the technology options that best suit a particular institution's needs, and this may include MOOCs as well as other online distance learning provision."(idem, 2014)

The high number of enrolled students requires teachers to structure and plan programs at the level of the instrutional design, which until then was not a condition *sine qua non*. Nathan Harden (2013) clarifies: "Technology will also bring future students an array of new choices about how to build and customize their educations. Power is shifting away from selective university admissions officers into the hands of educational consumers, who will soon have their choice of attending virtually any university in the world online".

However, as stated above, results are surprising researchers: many students enroll at MOOC courses, but few are completing them. According to data from a University of Pennsylvania research, only 50% of the students registered end up seeing a class at MOOC. And, on average, only between 2% to 4% complete the MOOC course they enrolled. The research was made with approximately 1 million students who enrolled in 16 MOOC courses offered by the same institution.

> "But more Penn research shows that some 80% of MOOC users around the world already have an advanced degree, casting some doubt on the democratizing notion. For that study, Penn surveyed 35,000 students in more than 200 countries who took 32 different Penn MOOCs. Around the world, the study found, it was the economic elite who was taking MOOCs. In Brazil, Russia, India, China and South Africa, 80% of MOOC students came from the richest 6% of the population." (Adams, 2013)

## 2.2 Digital Revolution in Education

In the last decades, several changes have been felt within the educational theories. There is a growing adoption of active and collaborative strategies, rather than a more traditional way of teaching and learning.

Authors such as Garry et al., (2002) analyze this change from a "listening-to-listening" approach, to a "learning by doing" approach, centered in the student. The translation and use of various learning theories, from the behavior or reinforcement (behaviorism), until the cognition and understanding (cognitivism, constructivism), culminating in the collaborative aspect and socio-cultural learning (socio-constructivism and practice communities), are multimodal aspects of education today.

The multimedia area has contributed to this change of paradigm in education, as researchers Clark and Feldon (2005) denote "multimedia instruction offers extraordinary benefits to education including a wide range of instructional options and, with adequate instructional design, considerable reductions in the time required to learn, the time required of expert teachers, and when large numbers of students are involved, the cost of learning."

Still in this approach, Klopfer, Osterweil, Groff e Haas's (2009) referred the connection between technology and teaching "technology can have a reciprocal relationship with teaching. The emergence of new technologies pushes educators to understanding and leveraging these technologies for classroom use; at the same time, the on-the-ground implementation of these technologies in the classroom can (and does) directly impact how these technologies continue to take shape."

The use of technologies in the classroom context of is a central focus of this thesis. However it will bot be focused on the technology in itself, but rather the construction and use of a specific software that facilitates and boosts the educational component.

The purpose of this study focused on the creation and application of serious games in circumstances well determined, both in a pedagogical perspective as in the didactics perspective.

Connolly et al. (2013) refers that the use of pedagogies and theories within the serious games is a complex task. Up to the date of this dissertation there is no theory (single and transversal) for the construction and analysis of serious gaming. “To encourage the use of games in learning, it is essential to develop a better understanding of the tasks, activities, skills, and operations that different kinds of games can offer and examine how these might match desired leaning outcomes both within serious games.” (Connoly et al, 2013)

It is of note that, like Jonassen and Reeves (1996) claim, the students should be endowed with digital skills in order to learn to represent their knowledge “some of the best thinking results when students try to represent what they know. Representing knowledge as a mindful task can be enabled by cognitive tools such as hypermedia construction software or electronic spreadsheets. Such cognitive tools require students to think in meaningful ways to use the application's capabilities and features to represent what they know.”

### 2.2.1 Theories and Pedagogies

The chapter on theories and pedagogies of education applied in specific educational environments is vital to the need to evaluate and respond to the integration and relevance of the use of serious games. Although we are aware there is no single and transversal theory on serious games, this does not mean that there are no references to theories and pedagogical models in its construction.

Accordingly, authors as Connoly refer that “(...) earlier games tended to be based on a behaviourist model while later games incorporate experiential, situated and socio-cultural

pedagogical models." (Connoly et al, 2013)

As Connoly says, and according to some authors (Radoff, 2011; Mayes & deFreitas, 2004; Egenfeldt-Nielsen, 2007) the concept of serious games was first associated with the behaviorist theory. However the current socio-constructivist learning field eventually prevailed, not only by scientific consistency, but by gradual acceptance by the research community.

"It's the behaviorist approach to games that channels inquiry away from the harder problems of immersion, cooperation and competition that is so important to creating successful game experiences. Behaviorism was popular in psychology because it seemed to offer some easy answers–some of which do work (such as certain forms of conditioning) yet which is built on an erroneously reductive premise that ultimately failed to be supported empirically" (Radoff, 2011)

In the behaviorist model the student/learner is passive in many situations of the teaching-learning process: receives the stimulus and has certain behaviors depending on the setting of stimuli (stimuli) received. These can be elements, sensations or ideas, so that each person's kowledge is organised by associations between stimuli and responses. When the connection between different stimuli becomes stronger, learning happens (Greeno et al., 1996).

"Behaviourism focuses on individual learning behaviour. Drawing on the theories of Pavlov, Thorndike and Skinner, it proposes that learning occurs through repetition of specific stimuli and specific behaviours coupled with reward and reinforcement, associating learning with automation as opposed to active cognition" (Orr & McGuiness, 2013)

Pavlov (1927), Thordnike (1913), Skinner (1974) in its investigations have questioned the learning as a change in behavior. This change is caused by external stimuli: in the behavioral theory, behavioral changes reflect and demonstrate differentiated learning forms.

The behaviorist theory implies a focus in the interactions system between the teacher and the student: the professor asks the question and the student responds. When this interaction is made several times, and reinforced with a reward, this action gives place to learning. (Gleitman, 1995; Saettler, 1968)

In this sense, Thordnike (1913) mentions the laws of exercise and effect. The law of exercise says that repetition is essential for the act of learning, and still continues to be predominant in the acquisition of reading and writing skills. (Good & Brophy, 1990)

"B. F. Skinner focuses primarily on human behavior as the result of complex interactions between the various punishments and rewards we receive from the environment. Through various studies on behaviour (utilizing pigeons and a contraption now know as a Skinner box, which provides corn as an immediate reinforcement), Skinner demonstrated that most organisms will perform repetitive behaviors for very litle randomly distributed reinforcement" (Wolf, 2001)

B. F. Skinner (1948), with initial premise in Thordnik's law of the effect, added a new work concept of his predecessor: the reinforcement. For the author, reinforcement is the result of increasing behavior, that is, "the strengthening of behavior which results from reinforcement is appropriately called 'conditioning'. In operant conditioning we 'strengthen' an operant in the sense of making a response more probable or, in actual fact, more frequent." (Skinner, 1953)

Unlike behaviorists, certain theorists such as Jean Piaget argue that the learner builds its own knowledge. According to Piaget (1975; 1978) we learned by contrasting the old and the new information, and is this balance between the "old" and new perceptions and experiences that allows the adaptation and organization, as well as the growth and change. "For constructivism, the knowledge in our mind is ideally a viable construction accomplished by individuals given their current experience with the environment. This knowledge does not account for any independent, external (i.e., ontological) reality (von Glasersfeld, 1982). It is

never found or discovered, but is actively construted (Rorty, 1991)" (Filsecker & Bundgens-Kosten, 2012)

While the constructivism is the theory of knowledge developed by Piaget and other theorists, in the constructionist learning theory, developed by Papert and by their colleagues in the MIT, the student builds knowledge, interacts and is not a mere receptor. Students learn by doing, within a network of knowledge, through true learning and practice communities. The key concept of all teaching-learning process is interactivity. The student is responsible to build the meaning of things, as it is considered that learning is an interpretative act in close interaction with the physical world and social. (Papert, 1980)

Papert (1990) adds that

> "We understand "constructionism" as including, but going beyond what Piaget would call "constructivism." The word with the v expresses the theory that knowledge is built by the learner, not supplied by the teacher. The word with the n expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least shareable...a sand castle, a machine, a computer program, a book. This leads us to a model using a cycle of internalization of what is outside, then externalization of what is inside and so on."

The author emphasizes the difference between constructionism and instructionism. In his book, Papert refers that: "I like to formulate a major theoretical issue as "constructionism vs. instructionism". This does not suggest that instruction is bad or useless. Instruction is not bad but overrated as the locus for significant change in education. Better learning will not come from finding better ways for the teacher to instruct but from giving the learner better opportunities to construct." (Papert, 1990)

On the other hand, Jerome Bruner (1999) stresses the importance and relevance of the cognitive development theories. The author defends the subject's active role in the construction of knowledge. Although the student is the center of attention, constructivism

allows for the social construction of knowledge through the notion of scaffolding technique (Wood, Bruner and Ross, 1976) where the tutor can structure the knowledge so as to be understood by the student, i.e. each matter to be taught should be previously structured, appropriately to the cognitive development of the learner. This support structure, scaffolding, "whereby the tutor embeds interventions within learning tasks that that are suited to the learner's capabilities and offers a step up to next learning age". (Orr & McGuinness, 2014)

In turn, Lev Vygotsky (1962) refers important aspects of social interaction in the act of learning: the subject only develops when he/she participates in various forms of social interaction. "Vygotsky focused on the learner's potencial in terms of the difference between what the learners can currently do and what is just beyond their capability (without the help of a tutor or teacher)." (Orr & McGuinness, 2014)

Holmes and Gardner (2006) refer that, to the socio-constructivist theory, learning is "social, reflective, authentic, scaffolded, progressive and experiential". O aspecto social desta corrente teórica "moves away from the individual learner and leads to the notion of 'learning communities' where people learn in collaboration with others in a wider social network" (idem, 2014)

The collaboration between learners is also analyzed in the Communal Construtivism theory. To Holmes, Tangney, FitzGibbon, Savage and Meehan's (2001) this theory consists in: "an approach to learning in which students not only construct their own knowledge (construtivism) as a resulto f interacting with their environment (social constructivism), but are also actively engaged in the process of constructing knowledge for their learning community".

Authors such as Johnson & Jonhson (1999) address, still, the need for cooperation between the students "the conditions under which competitive and individualistic learning may be constructive are best met when they are within the context of cooperation. What is learned cooperatively can be reviewed in a fun energetic competition. When students need simple skills and knowledge to contribute to a cooperative effort, individualistic learning may be helpful."

Siemens and Tittenberger (2009) analyzed the theory of connectivism in the social sense and connection between the people "connectivism is the view that knowledge and cognition are distributed across networks of people and technology and learning is the process of connecting, growing, and navigating those networks."

The concept of the Community, considering the resulting practices, is defined by Lave and Wenger (1991)

> "In using the term community, we do not imply some primordial culture-sharing entity. We assume that members have diferente interests, make diverse contributions to activity, and hold varied viewpoints. In our view, participation at multiple levels is entailed in membership in a community of pratice. Nor does the term community imply necessarily co-presence, a well-defined, identifiable group, or socially visible boundaries. It does imply participation in an activity system about which participants share understandings concerning what they are doing and what that means in their lives and for their communities."

Gee (2008) establishes the relationship between communities of practice and game. For the author, the game is the social setting, i.e. all the interactions that involve the game: "Gamers often organize themselves into communities of practice that create social identities with distinctive ways of talking, interacting, interpreting experiences, and applying values, knowledge, and skill to achieve goals and solve problems. This is a crucial point for those who wish to make so-called serious games: to gain these sorts of desired learning effects will often require as much care about the social system (the learning system) in which the game is placed as in-game design itself."

Egenfeldt-Nielsen (2007) suggests the dynamics of learning in practice communities, "you learn new things by participating in these communities and appreciating and negotiating that counts as knowledge, skills and attitudes."

This set of views is not pacific nor generates unanimities, researchers as Filsecker and

Bundegens-Kosten (2012) do not agree with the connotation that games "that support learning in communities of practice have higher demands on teacher engagement (which, strictly speaking, does not play any role in most traditional communities of practice, although it is highly relevant when working with practice fields) than games from earlier generations."

There is, however, a continued effort to progressively see game based learning as a contribute to lifelong learning, "most of what we do is precisely about learning as we go, practicing, breaking old habits, learning something else, admitting what we do not know, finding someone who does, getting feedback on a work in progress, failing, trying again, failing even worse, trying again, and so forth. There is no end-of-grade test, there is no grade point average." (Davison, C., 2012)

### 2.2.2 Games and Learning

One of the tendencies in certain areas of higher education, which is important to mention in this context, is the use of games as a tool in the learning process.

In the context of informal learning, learning trhough games is analyzed by several authors. In our context, we focus on serious games having education in mind instead of aiming on recreational component and recreation (Miller et al. 2011). Some researchers relate that these games allow a constructivist learning, situated and experimental, which is enhanced with the active testing and immersion throughout the game (Squire 2008; Haney et al. 2011).

Bidarra et al adds that "one of the reasons for the use of Information and Communication Technologies in education is the possibility of the relationship man-computer

allow situations of individualisation, favoring adjustments and rhythms of differentiated learning". (Bidarra et al, 2012)[28]

The whole game experience is relevant for the player to acquire skills and learn to apply them in everyday lives. In this sense, Karl Kapp (2012) explains that a player lets himself be enveloped by the game dynamics, due to instant feedback and constant interactions required through the course of the game.

In accordance with McGonigal (2010), in contemporary society, the computer and video games fulfill, in a certain way, the human needs that real space cannot satisfy, i.e. offer rewards and teach other paths. It is in the teaching of other paths that we consider essential the role of informal learning through the acquisition of new (and different) skills. Education has suffered modifications along the years, either by how it is understood by others, either by the role of the student in the learning process.

Piaget and Papert reflect on the role that the student should play in the learning process.

> "We understand "constructionism" as including, but going beyond what Piaget would call "constructivism." The word with the v expresses the theory that knowledge is built by the learner, not supplied by the teacher. The word with the n expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least shareable...a sand castle, a machine, a computer program, a book. This leads us to a model using a cycle of internalization of what is outside, then externalization of what is inside and so on." (Papert, 1990)

For many authors, in education, practices are still based on instructional models and there is a growing need to complement the curricula with models that give more relevance to the constructivist theory.

28 Translation from the original reference "uma das razões para o uso da Tecnologias de Informação e Comunicação na Educação é a possibilidade de a relação Homem-Computador permitir situações de individualização, favorecendo adaptações e ritmos de aprendizagem diferenciados"

Papert (1990) mentions that “I like to formulate a major theoretical issue as “constructionism vs. instructionism”. This does not suggest that instruction is bad or useless. Instruction is not bad but overrated as the locus for significant change in education. Better learning will not come from finding better ways for the teacher to instruct but from giving the learner better opportunities to construct.”

However, the parallel question that arises leads us to reflect on the education molds and in the (possibility of) integration of new tools in the educational context. Pivec (2004) analyzes the education and integration of new tools, “education can be seen as either a matter of the accumulation of factual knowledge, or as the forging of personal identity as someone in possession of particular expertise. Where the former model predominates, games may be seen as something of a distraction. If education is seen as being about the formation of identity however, play-like approaches, and the rule-based play of game settings, will be highly relevant.”

The current generation of students is already immersed in the digital world. This generation registers its moments digitally, shares them at the same time in social networks and has usually one or several electronic devices in their pocket. Thus, digital games are introduced in the same way as the other type of games.

McGonigal characterizes the digital age in a way that demonstrates and justifies the almost automatic apprehension that new generations, especially the last age groups demonstrate, “most of them have had easy access to sophisticated games and virtual worlds their entire lives, and so they take high-intensity engagement and active participation for granted. They know what extreme, positive activation feels like, and when they're not feeling it, they're bored and frustrated. They have good reason to feel that way: it's a lot harder to function in low-motivation, low-feedback, and low-challenge environments when you've grown up playing sophisticated games.” (McGonigal, 2011)

In this sense, Jessica Trybus (2014) reflects on the importance of the implementation of lifelong learning strategies based on the “with game-based learning tools to bridge that gap comes the promise of vastly more productive and engaged students and workers—ones who embrace learning rather than view it as a disruptive burden.”

Hubbard (1991) recognized, at the beginning of the 1990s, the potential of a game-based learning writing that “DGBL could become an integral part of modern language teaching methodology”. Two decades later, in 2011, Chik contrasts Hubbard’s argument and states that “digital games are more likely to be integral to many people´s leisure consumption with their roles in language teaching methodology... still questionable”.

According to Gee (2007), in the last five years, the potential of digital games in education has been pointed as a growth sector by educators mainly by the arguments of involvement, but also because it attracts more students to extra-curricular activities in comparison with other forms of media such as television, films and books (Gee & Hayes, 2011).

The research of digital games is centered on 'play' as an important element in the process of learning (Shaffer; Squire; Halverson & Ege, 2005) and also as an opportunity to "revisit core thinking around learning as experience" (de Freitas & Maharg, 2011)

The rhetoric associated with digital games has its voice in the anti-school speeches which refer that “formal educational contexts and objectives often have limited relevance to the immediate, and mediated, social, communicative and informational needs of students” (Purushotma, Thorne, & Wheatley, 2008). In opposition to this discourse, “game-based learning and simulations have been proposed as one antidote to the current situation” (Ang & Zaphiris, 2008).

In accordance with McKenzie “developers and educators are slowly ammassing some of the modular specialist skills and tecnology that make comercial game development so technically demanding” (McKenzie, 2012)

For Prensky (2001) the learning based on games (game-based learning) is fun and engaging and adds that “the coming together of and serious learning and interactive entertainment into a newly emerging and highly exciting medium — Digital Learning Games”.

This "medium" has shown - in multiple areas of teaching-learning - such as medicine, the military industry or the successful results in aviation related to the use of games and simulations. In recent years, several studies were conducted to understand the effective value of games in learning, in the broader sense, for various age levels and in different areas of knowledge, as mathematics (van Eck & Dempsey, 2002), software engineering (Cagiltay, 2007; Connoly, Stansfield & Hainey, 2007), civil engineering (Ebner & Holzinger v, 2007), management (Kiili, 2007), computer science (Patastergiou, 2009), geography (Tüzün, Yilmaz-Soylu, Karakus, Inhal & Kizilkaya, 2009), linguistic (Liu & Chu, 2010) and science (Chang, Peng & Chao, 2010).

In this sense, Prensky reflects on the need for digital natives to receive new influences and new forms and learning experiences, “we see the Digital Natives’ need for speed manifesting itself in a number of ways, including a demand for a faster pace of development, less “time-in-grade,” and shorter lead times to sucess. We need to create learning experiences that maintain the pace and exploit the Digital Natives’ facility with twicth speed while adding contente that is important and useful. Digital game-based is one of the ways we can do this.” (Prensky, 2001).

The need for reconstruction of curricula and its adaptability is analyzed by several authors. Justin Boyle (2013) makes the comparison between a well-designed game experience and a good curriculum “a well-designed gaming experience can be compared closely to a well-designed curriculum. Most games, educational or otherwise, begin with the introduction of basic skills, then a few low-intensity challenges, then a gradual increase in difficulty while imparting new techniques and providing pass/fail progress exams (or “boss levels,” as games call them). It isn’t much of a big leap from gameplay to scholastic progress.”

On the other hand, a 2013study, accomplished with university students reveals that students who have used the model based on games showed more motivation and have the highest rating in practical exercises when comparison with the traditional model. This study was published in *Computers in Education*. However, the students who used the traditional methods of learning showed to be more participatory in the classroom and had the best results in theoretical exercises. The study adds that despite the good results in the traditional methods evaluation, the students that have used the model based on games completed the course with higher averages. (Domínguez et al, 2013)

As the technology evolves serious games have a more important role in teaching, however, my study demonstrates that this does not mean a predominance or even a dominance when it comes to serious games. Despite this, we reinforce that this area can play important roles in specific strands of learning as for example, the virtual learning of pilots (already demonstrated).

### 2.3 To play or not to play, that is the question!

There are different scientific and anthropological explanations for the act of playing. Huzinga, 1938, analyzes this concept

> "play is older than culture, for culture, however inadequately defined, always presupposes human society, and animals have not waited for man to teach them their playing. We can safely assert, even, that human civilization has added no essential feature to the general idea of play. (...) All these hypotheses have one thing in common: they all start from the assumption that play must serve something which is not play, that it must have some kind of biological purpose. They all enquire into the why and the wherefore of play."

The word "play" has different meanings and varies from culture to culture.

> "In ancient German, the word for play is an abstract concept that could reference a drinking competition or deciding how to kill someone. In English, it more clearly indicates the exclusion of "seriousness". In other cultures, the word can be a reference for sexual conduct or a way of expressing laziness. Huizinga writes, "All peoples play, and play remarkably alike; but their languages differ widely in their conception of play, conceiving it neither as distinctly nor as broadly as modern European languages do" (Jeffries, 2010)

The term "game" is used in different contexts of daily life and in various scales of importance when refering, among others, the social, recreational or education components.

Games are very popular for its entertainment component and attract people of all ages. With the advent of computers and the Internet new forms of ludic games and/or education have been developed. They usually have a large amount of information - images, texts, sound, movies -, work with virtual representations, and may in certain cases be more appealing and absorbent that certain traditional games.

From the Ancient Greece games until today, there are different contexts and controversies associated to their use. Sherry Turkle stresses that “there has been controversy about video games from the days of Space Invaders and Asteroids, from the time that the games’ holding power provoked people who saw it as a sign of addiction to become alarmed. The controversy intensified as it became clear that more than a “games craze” was involved.” (Turkle, 1984)

In the social aspect of daily life the game is present both in the attitudes and in the actions of individuals. Crecente (2013) mentions the potential of games and the influence that always had in society as an artistic expression to interpret and explore old themes or unknown themes.

> “If games were the first medium to have a compelling influence over society, I could understand the obsession with imbuing them with powerful qualities of changing human behavior at a fundamental level. But this is not the case. As one of the more recent forms of artistic expression, games and their interactivity are providing us with a new way to explore ancient themes. I for one welcome more research into their uniqueness and their potential influence, as has already been profusely explored for the printed word, the film and other media." (Crecente, 2013)

Turkle analyzes the power of games, “video games are a window onto a new kind of intimacy with machines that is characteristic of the nascent computer culture. The special relationship that player’s form with video games has elements that are common to interactions with other kinds of computers. The holding power of video games, their almost hypnotic fascination, is computer-holding power. The experiences of video game players help us to understand this holding power and something else as well.” (Turkle, 1984)

The author presents an optimistic vision about the capacity of learning through games that simulate the real life. However, others - as Friedman (1999), Squire (2004) and Shier (2005) - present conflicting arguments. Many games have a high complexity and is both difficult to understand the dynamics of the game engine, as well as knowing its existence (as a player). Many games are developed to involve people and for such knowledge of the game mechanics is

essential. However, to have this knowledge is necessary a deepening of questions such as “aesthetic norms, genre conventions, ideological biases, and codes of representation”. In his doctoral thesis, Squire demonstrates the potential of a strategy game called Civilization III but reports the need for some guided activities to achieve the desired results.

The guided activities, in the words of Squire, can benefit with an intrinsic knowledge of the programming level of the game itself. In this sense, Turkle reflects on learning games programming as a child: “when you play a video game you are a player in a game programmed by someone else. When children begin to do their own programming, they are not deciphering somebody else’s mystery. They become players in their own game, makers of their own mysteries, and enter into a new relationship with the computer, one in which they begin to experience it as a kind of second self.” (Turkle, 1984)

This comparison of "second life" is also made by Jenkins when laying down the comparison between game and theater “games, like theatre, turn the mirror to our natures, to paraphrase Shakespeare” (Jenkins, 2013)

The logic of the theatrical game, hero versus opponent, believing that what is being showed is true it’s the basis for the creation of a game narrative. The creation of a sense of immersion follows these same parameters: “One of the keys to an effective virtual world is for the user to be able to “suspend disbelief”. That is, the user must be able to imagine that the world portrayed is real, without being jarred out of that belief by the world’s behaviour” (Bates, 1992). Since the time of SpaceWar that we believe in the representation of elements on a black screen. This screen is the interaction space, which makes us trust the "make believe". This interaction is based on anthropomorphic empathy, i.e. we understand the interactive environment “as whole computing system which manifests a dialog between the user and the machine” (Primo, 2005)[29]. This interaction with an environment of "make believe" is found to be intrinsically associated with empathy, i.e. the ability to “putting yourself in the place of

29 Translation from the original reference “como todo sistema de computação onde se manifesta um diálogo entre o usuário e a máquina”.

another, seek understands it up to feel what he feels (...) this is what allows us to express emotions in theater, or at the cinema" (Denigot, 2005:31-32)[30].

It is essential to highlight that games have always had a long and contiguous history in the development of almost every culture and society,

> "as a civilization becomes more complex, more variegated and more overladen, and as the technique of production and social life itself become more finely organized, the old cultural soil is gradually smothered under a rank layer of ideas, systems of thought and knowledge, doctrines, rules and regulations, moralities and conventions which have lost all touch with play. Civilization, we then say, has grown more serious; it assigns only a secondary place to playing. The heroic period is over, and the agonistic phase, too, seems a thing of the past." (Jeffries, 2010)

However, it is relevant to note that, as mentioned by Wittgenstein (1963), despite we could agree on whether something is or is not a game, we cannot agree with a definition that encompasses everything that is understood as being a game.

The revolution in the games framework, more precisely video games, happened in the beginning of the 1980s. "As the videogame revolution took off in the early 1980's, so did academic interest in games. To date, the field of game studies can be characterized not only as multi-disciplinary but also as inter-disciplinary". (Zagal, 2010)

As Zagal suggests, before the end of the 20st century, the academic studies on games was rare and limited to fields of study as history and anthropology "For example, in the early 1900's, Stewart Culin wrote a comprehensive catalog of gaming implements and games from Native American tribes north of Mexico (Culin, 1907), while Johan Huizinga explored the importance of games and play as a basic human activity that helps define culture (Huizinga, 1954)." (idem)

30 Translation from the original reference "colocar-se no lugar do outro, procurar compreende-lo até sentir o que ele sente (...) é isto que nos permite que nos emocionemos no teatro, ou no cinema"

### 2.3.1 Serious games: Analogy and Digital

“Our primary problem is that we have little theory on which to base our efforts. We don´t really know what a game is, or why people play games, or what makes a game great... We need to establish our principles of aesthetics, a framework for criticismo, and a model for development... “ (Crawford, 1982)

Chris Crawford, writes, in 1982, about his concern as a computer games designer and on the framework and development of the concept of game. The concept has different ramifications and extensions, as the different types of games require different analyzes. In the context of this dissertation, we will focus on serious games.

The word "serious" that composes the term serious games indicates the nature of this type of game: these are called serious because they withdraw the component of entertainment. Meaning the software or application is developed under the principles of interactive game and has an educational nature.

The term "serious games" was first used by Clark Abt. In his book, the author defines the term as “reduced to its formal essence, a game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context. A more conventional definition would say that a game is a context with rules among adversaries trying to win objectives. We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement.”

However, the term, as is currently used, was first used in 2002 by Serious Game Initiative. This initiative dedicated to serious games was developed in the United States by David Rejeski and Ben Sawyer. Only after this, has the movement of serious games advanced to Europe, in particular, to the United Kingdom. This initiative deals with the use of this type of game in the different educational and social contexts “on uses for games in exploring

management and leadership challenges facing the public sector. Part of its overall charter is to help forge productive links between the electronic game industry and projects involving the use of games in education, training, health, and public policy".

However, there are authors who state that the term - serious games - generates controversy. Ian Bogost says that "the games industry has never much liked the phrase "serious games," because it seems reductionist and derogatory, as if to claim that other sorts of games are worthless or pointless. Even among those of us who have worked to bring games to other domains, the name "serious games" has sometimes posed problems".

It is important to mention that serious games are used both in formal contexts and in the context of informal learning. Several are the fields of action of serious games, both in higher education institutions and in pilot training for example, as serious games are used as tools for reality simulation. "SGs were initially conceived to train people for tasks in particular jobs, such as training army personnel, or training insurance salesmen. These tasks were characterized by their specificity and applicability for particular work-related purposes and are typically targeted at a captive audience" (Belloti et al, 2010)

Jane McGonigal was one of the first researchers to explore the idea that we should not try to make games that are only alternatives to reality - but to try to make games to make the world a better and more immersive reality.

The author and researcher reveals that "gaming can make us better people". In her book, *Reality is Broken*, McGonigal says that games may help children develop concepts and capabilities needed to solve everyday problems, i.e. in certain circumstances games can help people win specific skills.

The use of games in the educational context is not recent. Traditional Games (not digital) were used to learn social behaviors and reactions to psychological stimuli. In 1958, the use of traditional board games and "role playing" were a tool in a formal education curriculum.

As an example, the Inter-Nation Simulation game taught international relations to students of secondary education and the game The Sumerian taught the economic implications in Mesopotamia in 3500 AC.

Knowing how to identify games for educational purposes is complex. The classification and characterization of serious games and their relationship with virtual worlds and simulation can be analyzed through different perspectives. In this case, games with a serious intent: they need to be immersive, and not necessarily fun, and the gain of skills can be implicit or explicit.

Educators are also beginning to recognize the potential os using games in educational context, “Educators are increasingly recognizing the potential of using digital games to engage students in interactive and collaborative learning environments. Multimedia elements, storytelling, challenge, competition, random access, parallel processing, immediate reward and low level of threat are all features which make many people prefer them to traditional learning media.” (Prensky, 2005)

Some types of games hold in them principles and models that are seen as potential to be explored by educators. The correlation between theory and practice allows you to create an environment where learning can be demonstrated in the context of use. This means that the use of serious games, when they are well conceptualised and constructed, can create a sense of immersion. Belotti et al (2010) report that “good SGs challenge players sense immersive situations, providing concrete, compelling contexts where the player gets concretely involved. This is important to motivate learners and also to show the concrete relevance to everyone’s life of subjects (e.g., maths and physics) that are frequently considered as cold and abstract, but whose applications to improve our understanding (and prediction) of the world and its processes are surprising and give satisfaction to students.“

In the MIT article on games and education there are several examples of games for the educational context, as is the case of Zoo Scene Investigators, Palmagotchi, Racing Academy, Ayiti, Gamestar mechanic, the calm and the Storm, Mind Rover, Lure of the labyrinth, the

Federation of the American scientists' immune attack. These are just some of the games that appear on the list referred above. The distinction and emergence of different categories of games in the education sphere - as is the case of games dealing with social changes, health games or advertising games – is also one of the issues stressed in the document. As such, the authors refer that serious games "span everything from advancing social causes to promoting better health to marketing. The class of games known as Games for Change is being designed with a social or political agenda to get people to consider particular issues. Members of Games for Health design games for both patients and practitioners with a medical purpose in mind. Advergaming is a popular form of advertisement that delivers commercial messages through games". (Belloti et al, 2010)

Pernin, Michaux, Mandran & Mariais (2012) indicate the importance of game principles such as competition, individual challenge, collaboration and recognition by the others. These aspects have been the driving force of motivation and the basis of success. According to Van Rosmalen & Westera (2012) teachers also use simple tools as serious games: which is the case of the use of wikis. There are still teachers who use templates to add or remove the content (Hummel, Geerts, Slootmaker, Kuipers, & Westera, 2013) or even those that use software game with simple and easy forms to publish (Torrente, Del Branco, Marchiori, Moreno-Ger, & Fernández-Manjón, 2010; Overmars, 2004)

However, it is important to highlight that there are opposite views who criticize the fragmentation of this study area (Ke, 2009). The attempts of categorization on this field of study have been developed by several authors,

> "O´Brien (2011) attempted similar categorisation for serious games distinguishing linear games, competitive games, strategy games and role playing games and tried to realte these game genres to the different cognitive functions that they support. Sawyer and Smith (2008) developed a taxonomy of serious games, categorising games according to the game discipline/function of the game (games for

health, education, business, etc.) as well as the sectors in which the games might be use (government and defence, healtcare, advertising, education, industry, etc)."

Kickmeier-Rust, Peirce, Conlan, Schwarz ,Verpoorten & Albert (2007) introduced the categories based on psychology and pedagogy of games. The taxonomy presented covers different dimensions:

- Purpose: between entertainment and learning/training
- Reality: between the imitation of reality and the fiction of contexts to help in the abstract vision of the game (as, for example, Tetris)
- Social involvement: between single players to multiple players
- Activity: between active and inactive games. For example, action games and game rooms where the action is passive (resembles a video).

In the school environment for a game to succeed it is necessary to contain some basic characteristics, "a serious game needs to be active, experiential, problem-based and provide immediate feedback (Boyle, Connoly & Hainey, 2011). Serious games must be enjoyable and motivate individuals to play until they reach mastery." (De Glória et al, 2014)

The educational component is, thus, in the context of these characteristics, one aspect to highlight. We should also note that the creation of content and software adapted to each learner is an added value for the learning pace of each student. "One of the most attractive features of serious games, and educational technology more generally, is the possibility that the software can be tailored to assess the individual learner´s skills and knowledge in real time as well as present new activities and concepts that are challeging but achievable at the learner´s own pace". (Blasko et al, 2014)

Student learning is a central factor in the context of the serious gaming. The field of serious games covers several thematics (Gredler 1992, 2004; Rieber 2005). The tools used are, in turn, interdisciplinary "very different disciplines are involved like text writing, software development, artificial intelligence, graphics design, video production, marketing, sales and many others." (Westera et al, 2008)

Authors such as Clark (2003) speak about the difficulties and concerns for the use of serious games in education and training. Clark defends that the objectives and characteristics of the games and the learning objectives may conflict "The 'suspension of disbelief', typically happening in a game, may negatively influence the learning processes. Certain socio-demographic groups may feel excluded and frustration may be created by usability issues and competition. There is a risk of stressing extrinsic motivation towards an educational topic (through competition, rewards, badges, etc.), with respect to intrinsic motivation, that is fundamental in the long-term." (De Gloria et al, 2014)

Another problem pointed out by authors as is the case of Raybourn (2014), is the use of a game as stand alone, i.e. an object not integrated into the structures of learning. The author gives as example the lack of game integration in MOOC "the use of serious games remains largely stand-alone, lacking interoperability of data models, and failing to adequately support self-paced learning outside of facilitated exercises. In addition many serious games lack the ability to detect the users' contexto and therefore cannot personalize instruction very well. Nor do many serious games in use scale up to train thousands of learners at any given time as a Massively Open Online Course (MOOC) would." (Raybourn, 2014)

Different actions should be taken in account in the near future with a view to integrate serious games in demands for training and education "If utilized as part of a system of experiences, serious games can serve as entry points into a comprehensive experiential training pipeline in which evolving content is delivered via diferent modalities and media throughout a learner's career." (idem)

### 2.3.2 Game Based Learning

In this context it is important to mention that one of the definitions for game-based learning is “it’s about making learning engaging Instructional content is blurred with game characteristics Computer games offer a programmed environment by which the student can play, experiment, and learn from mistakes and feedback...” (Pivec at al, 2003)

Some authors refer that “game-based learning can be defined as a computer-based learning methodology intended for educational purposes that supports student - centred learning in a significant way” (Sica, Delli Veneri, & Miglino, 2011).

For Remmele & Whitton (2014) “the game-based literature focuses on positive social game-playing behaviours, such as community-building and sharing”.

According to a study conducted by *Games and Learning Publishing Council (*Joan Ganz Cooney Center), the use of games in the classroom is increasing. Din Heiman (2014), on the same study, reveals that “We’ve learned that if you provide teachers a place to find quality learning games, games that engage and challenge students, tie directly into their curriculum, and play on the prevailing classroom devices within the boundaries of their lesson period – you will be literally overwhelmed with the response.”

Jordan Shapiro (2014) adds, “It is clear that digital games are becoming commonplace in the classroom. Teachers understand that games provide another instructional tool that’s not only engaging, but also simulates contextualized, or hands on, learning experience. The survey also confirms what I see every day: enthusiastic teachers are excited to transform school with creative implementations of edtech tools but they lack the resources and support they need to do so”.

With the analysis of the differences between the new generations of games when compared with the previous generation we can define some goals of game-based design:

- Learning with direction/purpose for students
- Create a culture of learning to match the interests of students and their learning styles
- Create learning environments that involve the students in an active way
- Give a more rewarding experience with the application of games.

The use of games within learning and its mechanisms of construction allow us to create a structure with rules, objectives, feedback, competition, challenges, opposition, interaction, representation, history (non-linearity).

These characteristics allow a different and appropriate learning strategy to the current generations of students. However, we must take into account that different students have different cognitive styles and different learning rhythms. The measure and the weight are not the same from student to student.

> "What are some of the most common problems people have with e-learning - or any type of training for that matter? It's boring. It's not challenging. People lose interest quickly. Yet, it doesn't have to be like that. There are lots of tools and techniques we use when we design e-learning to make it relevant and effective. Games are definitely among them. (...) What it does mean is using competition, problem-solving, story-telling, socialising and exploration to stimulate and enhance learning. Now that's not as easy as it might sound." (Gould, 2013)

The use of game elements may constitute an attempt to respond to the expectations of making teaching more interactive. The requirements of "digital natives"[31], a term coined by Mark Prensky is explicit with regards to learning. Some digital natives demonstrate forms of disinterest torwards the instruction/traditional teaching and prefer to get information from multiple sources, want rapid and frequent interactions with contents and have bigger visual literacy skills.

31 Prensky (2001) refers "What should we call these "new" students of today? Some refer to them as the N-[for Net]-gen or D-[for digital]-gen. But the most useful designation I have found for them is Digital Natives. Our students today are all "native speakers" of the digital language of computers, video games and the Internet."

"On the other hand, many DGBL proponents have been vocal about the dangers of "academizing" ("sucking the fun out of," as Prensky would say) games. This is partly the result of our experiences with the edutainment software of the last decade or so, which instead of harnessing the power of games for learning, resulted in what Professor Seymour Papert calls "Shavian reversals": offspring that inherit the worst characteristics of both parents (in this case, boring games and drill-and-kill learning)." (Eck, 2006)

But in what context comes the game-based learning?

Trybus (2015) refers that GBL deals with using some of the gaming principles to apply them in a real life context, so that is able to get the user (i.e., the students) involved in a positive way.

> "The motivational psychology involved in game - based learning allows students to engage with educational materials in a playful and dynamic way. Game - based learning is not just creating games for students to play, it is designing learning activities that can incrementally introduce concepts, and guide users towards an end goal. Traditional games can incorporate competition, points, incentives, and feedback loops. These concepts have become increasingly popular in higher education and in libraries as a way to engage students in learning." (Pho et al, 2015)

In accordance with the Horizon Report 2014, games and gaming is one of the trends for Higher Education. The application and development of games in educational environments is not instantaneous, needs time to settle. The report says, "the average age of today's gamers is 30, with 68% of gamers over 18 years old - university age" (Johnson et al., 2014). This is the age range of academic frequency at the higher education level.

Epper, Derryberry e Jackson (2012) identify five trends that can boost the adoption of games in learning:

- The students' expectations. Digital natives grew up with computer games. The time spent during the game can be considered an opportunity to learn, and the different learning opportunities may be present in games with distinctive characters. The simulation can be considered as the heart of the game “Digital simulations provide a learning environment in which the student can practice difficult, exacting, life - threatening, or mission - critical skills. (...) we are reminded that it is often the quality of the insight rather than the fidelity of the representation that most often determines the appeal of a game. This explains the continued popularity of games such as Go, Chess, Bridge, Monopoly, and other board games. High - fidelity simulations paired with gameplay dynamics and competitive game elements can increase student engagement and enhance learning.“ (idem)

- Data analysis: games are a constant interaction and can help in obtaining significant data about the student’s - what is his/her main difficulties, which is his/her skills, how he/she works individually and as a group. These data in conjunction with other may be the key to building a pedagogical approach and disciplinary action to transform the curriculum to be more appealing to students.

- Badges (medals) for learning: the digital learning badges can operate as a data collector of each student “While badges for learning are not, in and of themselves, games, the activities (usually called challenges, missions, or quests) that support the acquisition of badges can have a game - like quality. Further, the skill - building structure of games — which is both recursive and accretive — pairs naturally with badges for learning.” (idem)

- Mobile devices: the access to mobile devices has been increasing among students. The use of the QR code, geotagging, online check-in and accelerometers, are characteristics that encourage the use of games in the educational context. The use of these tools can improve the use of games and make the experience more enjoyable.

- Increasing use of social media: two to three thirds of Internet users use social media: make purchases, share photos and videos and use online games applications. “As social

media tools become more thoroughly integrated throughout postsecondary education, their usage within game - based learning is inevitable." (idem)

However, in spite of the trend for using different tools, authors describe some general difficulties that may lead to not use or postpone games in the classroom context. They are:

1. Many of the games proprietary from one institution and can not be used by others (proprietary software);

2. Difficulty to build games that join learning objectives and learning skills with storytelling;

3. Draw the game for all levels of education and in a way that pleases all students is almost an impossible task;

4. The development of a serious game involves a multidisciplinary team and can not have only the content provided by the teacher or expert;

5. Without having the right channel for the creation and development of serious games is difficult for teachers to find games with the necessary characteristics to use in the classroom context;

6. The cost for the development of a game continues to be very high (Epper, Derryberry e Jackson, 2012).

It is also important to highlight that the use of different elements in the learning environment have been used in order to motivate students to learn. The use of videos, sounds, and games within educational context has been a constant. When we analyzed the use of a game in this context there are elements that emerge, as is the case of intrinsic motivation.

Intrinsic motivation in a game is high: range of goals, winning from the other players, the fun inherent, the involvement in the game and the storyline of the game itself. The act of playing is *per se* immersive: to do something, to think and analyze, and to take decisions is challenging (physically, intellectually and emotionally).

In gaming, students have an active role in the performance of tasks and the acquisition of skills, instead of reading and listening passively. As they go and proceed in the game, they are at the same time completing the different levels of learning. They become personally involved: the projection of themselves into the game environment helps them to be more motivated in the process.

In this regard, Prensky (2001) mentions that there are changes in the cognitive and learning styles of digital natives, result of the technology influence of the use of games in their development. In the table bellow, we can analyze some examples of how the influence of technology and games has contributed to the development of learning. To know:

| | |
|---|---|
| Twitch speed | Conventional speed |
| Parallel processing | Linear processing |
| Graphics first | Text first |
| Random access | Step-by-step |
| Connected | Standalone |

| | |
|---|---|
| Active | Passive |
| Play | Work |
| Payoff | Patience |
| Fantasy | Reality |
| Technology-as-friend | Technology-as-foe |

**Figure 2 - Changes in cognitive styles, Prensky (2001)**

The author reflects on these changes, and highlights some key points to its analysis.

According to the author, when he talks about changes in cognitive styles, it is important to mention the "random access" which replaces the step-by-step procedure. The generation of game console players and computer players was the first to use the hypertext and the “clicking around”. Also Tapscot, quoted by Prensky, refers that children from the native digital generation receive and codify the information in different ways: multiple sources and less sequential. “This new, less sequential information structure has increased the Games Generation’s awareness and ability to make connections, has freed them from the constraint of a single path of thought. In many ways it is an extremely positive development” (Prensky, 2001).

McLuhan refers to how the communication has a preponderant role in the acquisition of information in a random manner “Our electronically configured world has led us to move from the habit of data classification to the mode of pattern recognition. We can no longer build

serially, block-by-block, step by-step, because instant communication insures that all factors of the environment and of experience coexist in a state of active interplay". (Mcluhan, 1964)

On the other hand, Gary Small et al. (2009) counter the argument of "random access" and add that "we sacrifice the depth by amplitude". The researchers have analyzed the quick access web search, virtually unlimited, to various information: the higher the amplitude of the search, the lower the deepening of the theme.

Another structuring element of Prensky's analysis relates to the "connectivity" in contrast with the "standalone". For the author, the digital natives were accustomed to be connected with the world: email, instant messaging, games with multiple users, chats and forums. In the words of Prensky, "The Games Generation's connectedness is both synchronous and asynchronous — anytime, anywhere, at almost no cost. The asynchronous part —email, newsgroups, bulletin boards — is now their prefered means of communication in many cases. The synchronous part — multiplayer games, instant messaging, voice telefone — use of which is now increasing because of bandwidth, is different because cost is no longer a factor. People can be contacted, spoken to and played with — somewhere in the world — 24 hours a day." (idem)

In this sense, first as a result of connectivity, and second, according to Prensky, the digital natives tend to think differently on how to access information and solve problems. Access to the Internet and its array of solutions changes the form of access and encode information.

Sherry Turkle (2011) refers that communication, which is not mediated by technology, teaches "skills of negotiation, of reading each other's emotion, of having to face the complexity of confrontation, dealing with complex emotion". And she adds that relations mediated by technology reveal a new form of intimacy (not between people, but between people and the machines): "as sociable robots propose themselves as substitutes for people, new networked devices offer us machine-mediated relationships with each other, another kind of substitution.

We romance the robot and become inseparable from our smartphones. As this happens, we remake ourselves and our relationships with each other through our new intimacy with machines".

Another aspect analyzed by Prensky is the difference between play and work. "Members of the Games Generation are often derived in the press as intellectual slackers, but in reality they are very much an intellectual-problem-solving-oriented generation".

The use of puzzles, memory games, LEGO construction, among others, can be understood as ways to play, when in reality, they are methods of resolving problems and real issues. The capacity of abstraction is fundamental for the resolution of problems and, by using these tools, achieve the goals proposed. Kilkku (2014) refers that in the case of LEGO, the objective is to achieve a solution to the initial problem "the problems can be engineering problems, in which the students receive different shapes of bricks, or they can be collaboration problems, in which the students receive different colors of bricks. The number of students participating in a task can differ, as long as there are unique shape or color combinations available."

However, as Carbonaro et al (2004) highlight, the use of these tools can be a disparate topic of the idea of learning only with technology "for many teachers and educators, this requires a conceptual shift away from the idea of learning from technology, often found in traditional computer-assisted instruction, toward a viewpoint of learning with the technology that is consistent with the "Mindtools" approach to problem-solving advocated by Jonassen (2000)"

Thus, the challenge is to realize the mechanics of games as a form of work, i.e. some strategies and problem resolution that can be used to streamline the working method.

Finally, one of the aspects that Prensky refers when analyzing the changes that separate native and digital migrants is the duality between fantasy and reality: what is

considered real and what is consider illusion. According to the author, the digital natives begin to include in work environments the concept of fantasy "companies already run by Games Generation individuals generally have much more informal settings, and often have special rooms for games, miniature golf, and "fun" activities. Microsoft's "campus" is full of indoor and outdoor play opportunities." (Prensky, 2001)

Moreover, these game opportunities can increase the degree of creativity and imagination. For example, some labs use LEGO in their workrooms to resolve complex issues of objects, software, or web sites construction, etc. It is a model that uses LEGO Serious Play in order to contribute to problems resolution. This method has the objective of "facilitated meeting, communication and problem-solving process in which participants are led through a series of questions, probing deeper and deeper into the subject. (...) 3D models serve as a basis for group discussion, knowledge sharing, problem solving and decision making"[32]

### 2.3.3 Serious Games and Motivation

The theme motivation in the context of serious games can be understood through two settings, in the words of Remmele & Whitton (2014) "the idea of "motivation" in the context of games is used in two related, but distinct, ways. There is the motivation to play a game in the first place. This is what Salen and Zimmerman (2004) refer to as the "seduction" into the magic circle that must necessarily occur before a player is willing to take part in the gaming activity at all. Secondly, there is sustained motivation to continue to participate in the game, commonly termed engagement".

Thus we can say that motivation for a player can be understood through the process of seduction by the game dynamics, i.e., even without being an integral part in the game, the player feels seduced to participate. Brenda Laurel quoted by Carlos Correia, states that it is the

32 Retrieved from http://www.lego.com/fr-fr/seriousplay/the-method

"ability that humans have to participate in actions in a context of representation". (Correia, n/d)[33]

This need for participation is justified by the empathy, which the player feels in relation to the game. Lankoski (2007) refers (on empathy) that "Games with anthropomorphic characters can widen the range of means to infect affects to players: they can employ empathy. With empathy I mean processes that puts ones affects in relation to another's affects, regardless if another is person or character from film or game". The player feels involved in the game dynamics, being a participant actor that reacts to attributes, challenges and effects throughout the game. These characteristics allow a greater involvement in the game.

The motivation may be intrinsic or extrinsic, i.e. the intrinsic motivation refers to each player internal motivation to complete a determined step or job with dedication. The extrinsic motivation is the external factors such as a reward, for example, that can influence the way of playing and the will to play.

> "Behavior can be intrinsically and extrinsically motivated. Most models have emphasized intrinsic motivation, focusing on the motives to perform a task that are dereived from the particpation itself (Malone, 1981; Malone & Lepper, 1987). Malone (1981) proposed that the primary factors that make an activity intrinsically motivating are challenge, curiosity and fantasy and specifically applied this framework to the design of computer games. It has been shown that those with intrinsic motivation to learn the material are more likely to "stay with it". Intrinsic motivation can be achieved by creating a more construtivist interaction with the game (Vos, van der Meijiden, & Denessen, 2011)

Blasko et al (2014) highlight the importance of being an immersive game as a single unit, as the task to learn how to play and motivate to play is also difficult to achieve: "Not only must a serious game teach the player to attain play mastery, which is itself a difficult task, the game

33 Translation from the original reference: "capacidade que os humanos detêm de participar em acções num contexto de representação"

must then remain engaging while teaching an appropriate “real-world” lesson of some kind. Considering the general difficulty in teaching them to play and to also motivate them to learn external content is doubly challenging”.

The ability of conceptualisation and development of serious games is the point of analysis to evaluate motivation. The use of the right software and hardware to fit the needs is essential to the player’s motivation. The interaction between the player and the fictional characters of the game is also a very important factor.

Aristotle in his Ars Poetic (16th century IV A.C.) defines empathy. This necessarily implies a mental and emotional identification, in this case, with the action that is watching, i.e., the link between the actor and the public. This identification with what we are seeing is one of the foundations of game interaction.

Johnson, Vilhjalmsson and Marsella (2005) explain that one of the ways to achieve this interaction is to promote the relationship between the player and the game characters through voice recognition and natural language processing in order to create an environment that is more intuitive. Blasko, Lum, White & Drabik (2014) add that there is a smooth construction in the communication between player and fictional character “when the learner is engaged in a conversation with a non-player character, there is a give and take between the characters. If the flow is constant, the interaction of action and reaction between the user’s actions and the game’s response will seem effortless and may lead to a higher level of self-efficacy. It may also be prudent to provide tutorial scaffolding while not interrupting the gameplay flow or learner performance.”

The recognized "scaffolding”, pointed by authors Blake et al (2014), is a base for knowledge construction as a player/student. Vygotsky (1978) considers that the students need to be guided in the application of their knowledge. Note that this support should be in accordance with the needs of the students and with autonomy as a goal “diminishing coaching: learning is promoted when learners are guided in their problem solving by appropriate

feedback and coaching, including error detection and correction, and when this coaching is gradually withdrawn." (Merrill, 2002)

When playing there are some elements precluded to build motivation. This is the case of the learning badges. These are considered a prize and are used by students to show that they have fulfilled their objectives. These kind of medals started with the Open Source Community Mozilla Firefox in 2011, the year in which was launched the first set of badges.

In recent years, many were the badges implemented either by the Foundation Mozilla Firefox, or by other entities that followed the trend: "the Open Badges framework is designed to allow any learner to collect badges from multiple sites, tied to a single identity, and then share them out across various sites, including personal blogs to social networking channels. It is critical for this infrastructure to be open to give learners control over their own learning and credentials, allow anyone to issue badges, and for each learner to carry their badges with them across the Web and other contexts." (The Mozilla Foundation and peer 2 peer University, 2013)

The main objective is for each student to use their badges to demonstrate the different goals (The Mozilla Foundation and peer 2 peer University, 2013). The player collects the badges and puts them in his/her virtual backpack and is then able to show them in any digital platform as a personal website, social network or on a blog, "a collection of badges can function as a distributed portfolio that may eventually be accessible from a variety of social media sites, such as LinkedIn, Facebook, and Google Plus. When badges serve as part of a résumé or portfolio, they tell prospective employers a more detailed story about the projects and activities that define a student's learning, including both the hard and soft skills that were acquired."(Jackson, 2013)

With this "digital backpack" and the demonstration of badges, one seeks to recognize the capabilities that are not easily assessed on a scale of traditional teaching. These acquired skills are recognized through the badges and are achieved, most of the times, outside the classroom context.

EDUCAUSE website refers that these medals of learning “offer talking points for a job interview, opening a friendly dialogue between a manager and an interviewee and allowing the latter to speak about accomplishments and interests that might not otherwise arise in conversation”. (EDUCAUSE, 2012)

There are several institutions that use badges, for example of the Khan Academy, which uses badges to motivate their students: “offers a lengthy web page of them, such as an “Atomic Clockwork” badge, which requires a student to watch videos or hone a skill for each of 30 consecutive days”. (EDUCAUSE, 2012)

Also the MITx uses badges in their study groups. In OpenStudy whenever a student gives a proper and timely reply, there is a reward in form of a badge.

Various projects were recognized by the use of digital badges in education in the annual projects competition on Digital Badges, John D. and Catherine T. MacArthur Foundation, Gates Foundation and Mozilla. In 2012, in the badges competition for Lifelong Learning, there were over 2 million dollars in research scholarships for the development of innovative systems using badges.

With the construction of new usage models for badges it is expected that the idea to deliver a symbolic 'prize' by the goals achieved can positively influence the involvement and learning. For example, the badges can provide focus on objectives, more challenging tasks, better educational performances, power of choice and authenticity (Dickey 2005).

Caryn Swark refers that “badges are just another form of grading, or - worse - extrinsic rewards (…) Badges can be extrinsic rewards, but they can also provide intrinsic motivation, especially for students who like clearly spelled out expectations. Provided they're optional, they shouldn't negatively impact any student's learning.” (Swark, 2012)

However, Resnick denotes that, “the problem, for me, lies in the role of badges as motivators. In many cases, educators are proposing badge systems in order to motivate students. It’s easy to understand why educators are doing this: most students get excited and engaged by badges. But towards what end? And for how long? I worry that students will focus on accumulating badges rather than making connections with the ideas and material associated with the badges (...).” (Resnick, 2012)

For its part, Henry Jenkins refers that “there is a value in helping these youths find ways to value what they are doing as intellectual pursuits, and there is a value in seeking to validate these experiences and help them learn how to mobilize that knowledge as they learn to work through the formal structures that exert power over their lives. But making badges too central to the process may alienate them before they have a chance to exert ownership over the knowledge they are acquiring." (Ash, 2012)

It is important to mention that the empirical studies reflect on the effects of the badges in education, Abramovich et al (2013) analyze the relationship of motivation with badges “the motivation relationship between badges and motivation for low performing students was limited to participatory badges. Skill badges earned by the low-performing students did not correlate with the change in performance avoidance goals. Not only do we conclude that different types of badges will have different effects on student motivation to learn but we also conclude that different types of badges will also affect learning performance”. (Abramovich, et al, 2013).

### 2.3.4 Serious Games and Evaluation

Both the motivation as the assessment are fundamental aspects in the teaching-learning process. The assessment in the context of serious games is becoming a point of central analysis to conceptualize and develop games with educational nature “serious games are developing a

reputation with some educationalists as a useful supplementary approach for teaching and learning. Two important issues for serious games application developers and educationalists are how the learning is assessed and how assessment is integrated into a serious games application." (Conolly et al, 2013)

Michael and Chen refer that "serious games like every other tool of education must be able to show that the necessary learning has occurred." Bellotti (2013) acrescenta que "for serious games to be considered a viable educational tool, they must provide some means of testing and progress tracking and the testing must be recognizable within the context of the education or training they are attempting to impart."

At the time of game development, evaluation is one of the strategies used for the construction and solidification of knowledge. The use of badges for motivation is frequent and the use of assessment with feedback becomes the voice to make the acquisition of knowledge real. The feedback is important for the student: realize what is being done in the correct way and what is being done in the wrong way. "Almost all games already provide forms of both assessement and feedback; in fact that 'make mistakes, learn and improve' cycle is often encouraged and scaffolded by clever in-game feedback, helping the player to first lern how to play and then develop their skill as they move through the game." (Bellotti, 2013)

In all stages of the game, the student is faced with formulation of hypotheses, test and revision. "This interaction occurs quickly and in the course of the game with immediate feedback. The games that are not engaging, per standard are not motivators. Good games that require constant action on the part of the player and with constant feedback are more motivating for the student". (Van Eck, 2006)[34]

But how can we integrate the feedback with the evaluation in the context of serious games? Belotti (2013) explains

34 Translation from the original reference "Esta interacção processa-se de forma rápida e no decorrer do jogo com feedback imediato. Os jogos que não são envolventes, por norma não são motivadores. Bons jogos que requerem acção constante por parte do jogador e com feedback constante são mais motivadores para o aluno"

> "generally speaking, assessment can be described as either (i) summative whereby it is conducted at the end of a learning process and tests the overall achievements, and (ii) formative whereby it is implemented and present throughout the entire learning process and continuously monitors progress and failures. With respect to serious games, it has been suggested that formative assessment is particularly useful and should be used particularly given that such assessments can be incorporated in to the serious game becoming part of the experience, in particular through appropriate user feedback."

Also the idea of progression is part of games, as is the case of the design and development of the different stages and levels of a game "the idea of progression too, where academic assessement gradually raises the bar to improve students' performance over the longer term (e.g. harder, or more critical, or more reflective, skills are required as the course or academic level progresses) has an almost direct parallel in certain games using levels or stages of increasing difficulty, where players are tested, and rewarded, at a higher level, asthey progresso through the game." (idem)

> The use of games with the exploration of all its structuring elements can be a way to rethink the design of the evaluations in order to make the evaluation more interesting

> "the use of games concepts as a way to rething assessement design and make it more relevant and useful for students is a compeling one, moving on for simple pointsification and approaching what might be termed implicit assessment: assessement that is woven into the subject and student´s activities so closely that it becomes a natural part of the activity. (...) Full implicit assessment can be obtained when games-based approaches are applied to the course as a whole, assessment included. More than a combination of game-based learning and traditional assessment, this approach uses game concepts during the course design phase, so that the resulting teaching, learning and assessment are invisibly entwined". (idem)

However, Michael and Chen (2005) refer that the full use of the player's evaluation process in order to verify the degree of learning with the game is very low. And add, "The information logged can be used to assist teachers with their assessments of the students. Teacher evaluation is a combination of both completion assessment and in-process assessment. Despite the predictions (or fears) of some, serious games aren't going to be replacing teachers anytime soon, and probably never. To that end, serious games should include tools to assist teachers in their evaluation of students. Such tools can include homework and assignment controls, grade tracking, reporting, and more."

## 3. METHODOLOGY

In the first phase of this study we have reviewed the literature analyze the different strategies for the use of e-learning and game based learning. The literature review aimed to analyze the digital (r)evolution both in the prism of communication and in the prism of education, as we consider that when it comes to digital learning both are inseparable.

In a second phase we proceeded to the description of the different case studies and respective development phases: concept, implementation, analysis. We intended to demonstrate, in a descriptive way, all the elements necessary to clarify the complexity of the object of study.

In this third phase, we will progress to the descriptive analysis of the case study and, subsequently, the field analysis with the selection of a sample with the necessary characteristics for conducting the study. The goal was to draw practical results from the games integration in a real learning environment.

### 3.1 Research Methods in Digital Media Education

The use of measures of analysis in digital learning has been the target of an array of approaches and perspectives (Peraya & Charlier, 2007; Reigehuth, 1999; Reeves, 2006, Coutinho, 2005).

In a field where the qualitative method used to be the primary analysis, it is now considered necessary to include other traditional methods of research: as is the case of quantitative methods or mixed methods (qualitative and quantitative).

Authors such as Salomon & Clark, 1977; Winn, 1989; Clark & Sugrue, 1991; Salomon, 1991; Pereira, 1993; Bartolomé & Sancho, 1994; Savenye & Robinson, 1996; Thompson,

Simonson & Hargraves, 1996; Bauder, Mullick, Corr & Sarner, 1997, soon understood this need to use different methods in the study of digital learning.

In fact, quantitative and qualitative research methodologies are the most used methods. This mixed methodology corresponds to the possibility of having different methods from different theoretical frameworks to coexist. Bernstein (1996) explains

> "We are all models - some are more explicit than others; all we use principles of description - again some are more explicit than others; all we have established criteria that allow us to produce our own descriptions and read descriptions of others - again these criteria may vary in their expression. Some of our principles can be quantitative limits while others are qualitative. But the problem is fundamentally the same. In the end, who is the voice that speaks? I prefer to be as explicit as possible. Well, at least, my voice can be deconstructed" (Bernstein, 1996)[35]

In order to understand the use of mixed methods, we consider its important to introduce the general moulds for qualitative methods and quantitative research methods, in accordance with Simões, C. & Paiva, J. (2004):

*Qualitative Research Methods*

- In qualitative research "the research plan is flexible";

- Qualitative research is "descriptive". The description must be rigorously and a direct result of the collected data. The data include transcripts of interviews, records of observations, written documents (personal and official), photographs, video recordings, etc.. The researchers analyze the notes taken during field work,

35 Translation from the original reference "todos temos modelos – alguns são mais explícitos do que outros; todos utilizamos princípios de descrição – novamente alguns são mais explícitos do que outros; todos estabelecemos critérios que nos permitem produzir as nossas próprias descrições e ler as descrições dos outros – novamente esses critérios podem variar na sua explicitação. Alguns dos nossos princípios podem ser quantitativos enquanto outros são qualitativos. Mas o problema é fundamentalmente o mesmo. No final, de quem é a voz que fala? Eu prefiro ser tão explícito quanto possível. Assim, pelo menos, a minha voz pode ser desconstruída".

the collected data, respecting as much as possible, the manner in which they are registered or entered;

- The researcher is the "instrument" for data collection; the validity and reliability of the data depends very much on its sensitivity, knowledge and experience (the issue of objectivity of researchers is the main problem of qualitative research);

- In qualitative research “the central concern is not whether the results are likely to be generalized, but which other contexts and subjects they can be generalized to”. (Simões, C. & Paiva, J. (2004)[36]

*Quantitative Research Methods*

- The quantitative research implies that the researcher draws up a structured plan before starting field work, in which the objectives and procedures for research are described in detail;

- The preparation for the plan should be preceded by a review of the pertinent literature available, essential not only for the definition of the real work purposes, but also for the formulation of hypotheses and for the variables definition;

- The objectives of quantitative research essentially consist in finding relationships between variables, make descriptions using the statistical data treatment of the and test theories;

- Whether it's an experimental investigation, or a statistical characterization of a given population (for example through the administration of a survey by questionnaire or structured interview), the selection of the sample must

36 Translation from the original reference “a preocupação central não é a de saber se os resultados são susceptíveis de generalização, mas sim a de que outros contextos e sujeitos a eles podem ser generalizados.

> be representative of the population under study, so that results can be generalized to the same population, which implies a random selection of subjects of research. (Simões, C. & Paiva, J. (2004)

After this brief description of the qualitative and quantitative methods it is important to note that one of the main limitations of quantitative methods in Social Sciences is related to the nature of the phenomena under study: the complexity of human beings; stimulus that leads to different responses according to the subject; a large number of variables difficult or even impossible to control; the researcher subjectivity; the measurement is often indirect, as is for example the case of attitudes, plus the problem to validate and the reliability of the measuring instruments.

In this sense, it is fundamental, when mixing the two methodologies, to explain how we consider the mixed method of analysis the most convenient for this study case.

With the use of the mixed method the researcher can conduct an investigation with the two types of data analysis “for example, a researcher might conduct a survey and use a questionnaire that is composed of multiple closed-ended or quantitative type items as well as several open-ended or qualitative type items.” (Jonhson, n/d) The author add that one of the advantages in the use of mixed method in research in the area of education is to find different analyzes and possible solutions resulting from the combination of the different methods and models. “When different approaches are used to focus on the same phenomenon and they provide the same result, you have "corroboration" which means you have superior evidence for the result.”

### 3.2 Research Design

Research design is an important element to define at this stage. As stated previously, the literature review was a fundamental element of the research methodology on serious games. After the review, we proceeded to the description, conceptualization and analysis of the case study, which will be present in chapter 4.

The design and development of the first set of games was based on the scheme presented in figure 3 by Iza Marfisi-Schottman et al, 2009. This figure represents the diversity of skills of the serious game development team: from creativity and conceptualization to the development of contents, design, infographics and programming. All the researchers participate not only in their competences, but also in their active participation in the overall process, problematizing their own and others' work stages and processes. This interactive research system is one of the most valuable work in the research center. In this case was enhanced by the external evaluation that elements of the Portuguese Association of Insurerances made of the seven games contracted with CITI.

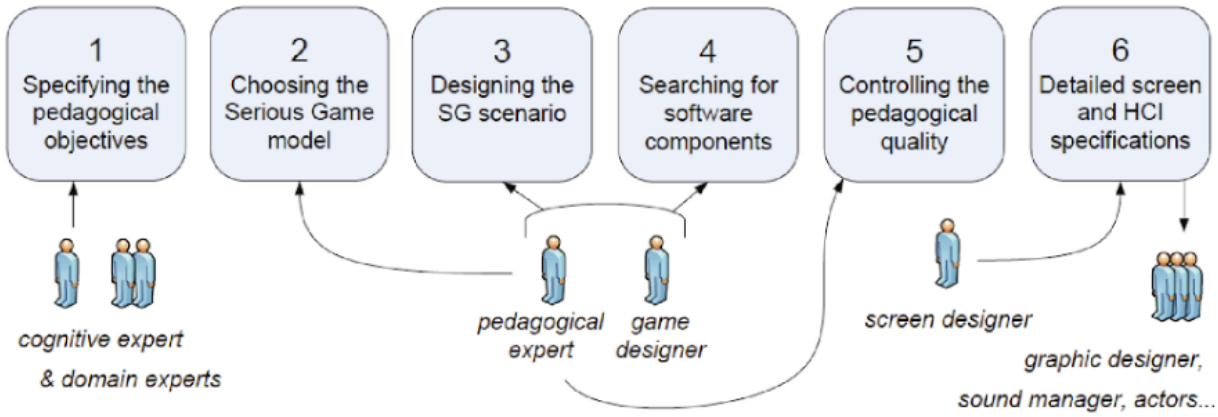



**Figure 3 Metodology for the first set of games**[37]

37 Retrieved from ECGBL2009 - 4th European Conference on Games-Based Learning de Iza Marfisi-Schottman et al, 2009 (pp.228)

In this sense, and as shown in figure 3, we began by specifying the pedagogical goals that were intended to be achieved. The research team in active collaboration with the Portuguese Association of Insurerances elaborated the objectives. Subsequently, the principal investigator, together with the team, chose the serious game model; then was made the design of the different scenarios of the games; and looked for the best software components. It should be noted that all steps had quality and pedagogical control in order to follow the procedures necessary for a good evaluation of the pedagogical objectives and competences for the game. After these procedures were made the specifications of interaction and usability, with detailed screens and properly programmed and commented as well.

This development cycle was followed for the first set of games since they were built for different target audiences. Each audience corresponded to a distinct development cycle. This development methodology only makes sense if it is done by a cohesive team that shares the same goals. In its opposite, and as the researchers refer, "practice has shown that it is very difficult getting all these actors to collaborate and communicate in an efficient way. This is mostly due to the fact that they come from very different domains and have various objectives and tasks"(Iza Marfisi-Schottman et al, 2009).

However, given the vicissitudes found in the development of the first set of games, it was necessary to readjust the methodology used to conceptualize the game Alpha Patrol.

Bordwell states, in 1985 “Games media open a new space (virtual) for the mediation of knowledge, for the enhancement of knowledge construction in the receptor, through the well-known mode of learning by doing processes of inference on the part of the receptor, processes that involve active and associative thinking” (Bordwell, 1985)

And in this context it was essential to readjust the methodology to the objective of the research partner, the Portuguese Association of Insurers. The sponsorship of the Portuguese

Association of Insurers has always had a first great goal: to explain to the youth the importance of insurance as a pillar of the functioning of contemporary societies. To this end, the following development strategy was established: from the book on “Catástrofes e Grandes Desastres” written by Ana Maria Magalhães and Isabel Alçada, an agreement was reached with the authors, so that the book, in analogical format, attached in its cover a serious game about the catastrophes from which born insurance concept in modern societies. This was the ideal terrain to create a game in which the text of the writers integrates and justifies the levels of the game and is a *sine qua non* condition for the player to be able to progress in the different levels.

The relationship between the book and the game is made through the information contained: in order to advance in the game, some clues are provided, but the player is encouraged to consult the book for more information and thus to be able to respond correctly to the different exercises that arise. By any incorrect answer about the importance of insurance, always penalizes the player.

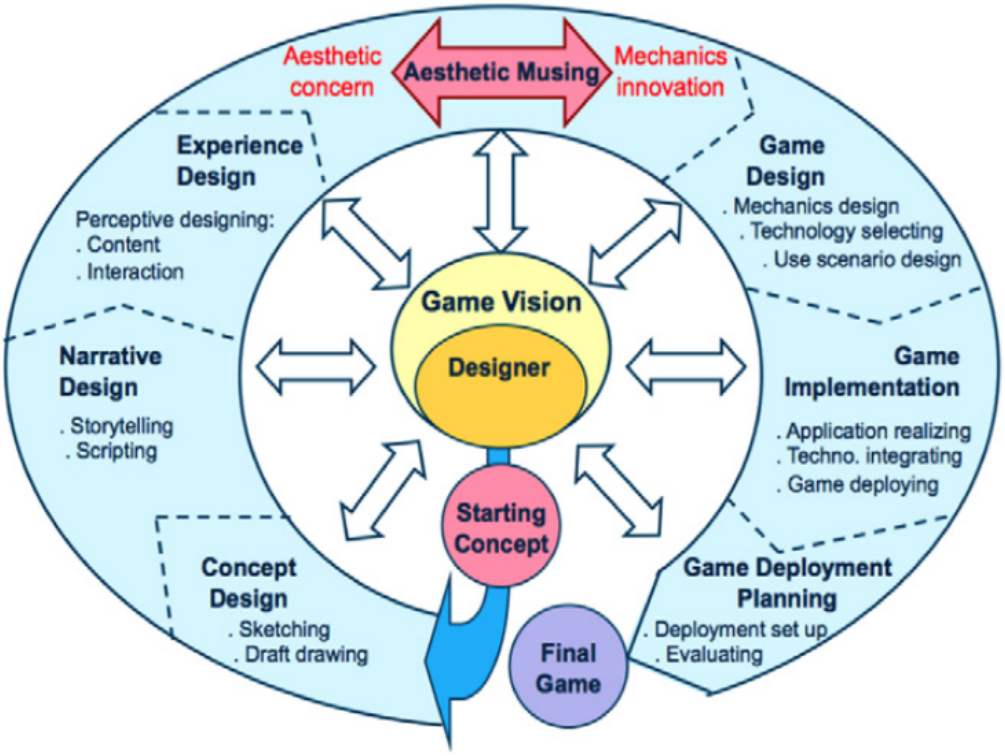



**Figure 4 Alpha Patrol Metodology**[38]

Figure 4 represents the model used in the construction of the alpha patrol game. This model was developed by Adérito Marcos and Nelson Zagalo and demonstrates the importance of narrative. In the present case, the storytelling in this game was one of the basic points of conception and development of the game. The research team was the same, with similar functions, however, in methodological development the whole design of the experience and interface of the game has always been in close relation with the narrative. This narrative first followed by the authors' book and later using the narrative with different elements of game.

The authors state that “the main goal of the writer is to tell the narrative in the greatest detail in order to develop a strong fabula or mental story in the receptor’s mind. In film, the narration gains new media terrains by making it possible to show instead of tell. Film does not

38 Retrieved from A. Marcos, N. Zagalo Entertainment Computing 2 (2011) pp.147

need to spend time explaining details because they are shown. The story world comes ready-built to the receptor, proposing direct perception of the visual world that enhances perceptive emotions and so, learning." (Marcos & Zagalo, 2011)

This model also differs in the part of the evaluation that was necessary to do with the target audience of this game in order to obtain a little more consistent results.

This change of strategy in the design and development of serious games, we had the need to make the evaluation by the students. In this sense, we will present the methodology used in the empirical study.

These are the main guidelines of the methodology used in the evaluation of the study, which will be explained in more detail throughout the chapter.

All this developed plan - non-experimental plan - was used since among other situations, when the investigator tries to find out how the variables of his study are related, in the case of this study it is quantitative because it does not explain a social phenomenon but rather it presents what is (Stern & Kalof).

The type of investigation used was the quantitative method. The instrument chosen for the data collection was the questionnaire survey: a 5-point likert scale was used where each student was asked to indicate the degree of agreement in a list of 5 categories from little useful to very useful.

In this sense, the methodology of the study followed was pre and pos questionnaire survey among the different stages of game experimentation in school environment. These surveys were conducted in April 2016: initial survey on expectations, playing habits, previous knowledge on the subject and the use of games in a classroom context; pos inquiry with questions about the game, the narrative, different types of perception about the experimentation of the game, global and specific assessment of the game and the gameplay.

The construction of the surveys followed the model of evaluation of serious games proposed by Savi, Wangenheim, Ulbricht & Vanzin (2010).

In relation to the sample for this study: the school was not selected by random probabilistic method, but deterministically. It was previously a sample that was previously selected or pre-determined (P. Levy & S. Lemeshow). In order to avoid the mortality situation of the sample, it was intended that the number of students selected had predefined characteristics that guarantee undistorted data, and there was concern that there would be no non-response. Return was 100%. As is well known, entrance into schools is not a simple task and in that sense the choice of school was made by the availability of the direction, teachers and students to collaborate with this project. The convergence between school curriculum planning and the planning of my study was essential.

The case studies have been conceptualized and developed by C.I.T.I. In order to meet the brief, and after putting the theoretical reflection in practice, there are some reflections on the theme of serious games that are important. The question that is evident in this process is to understand the reason why we opted for the creation of games, and not by the use of serious games that are already on the market. In order to consolidate this research on the strategies to use with serious games, and after the theoretical reflection and the definition of process and procedures, we must control the whole process and the guidelines, which arise from it to better, understand the subject as a whole. Moreover, this line of research follows the goals for the biennium 2016/2018 set by the C.I.T.I's directors, as to deepen the theoretical foundations as well as the practice foundation related with literacies and use of serious games.

To achieve substantive findings in this thesis, we proceeded with a literature review and a case study. Thus, it becomes relevant to explain the use of the case study in the field of digital media. For Coutinho & Chaves (2002) "the Case Study is an empirical research (Yin, 1994) which is based on inductive thinking (Bravo, 1998; Gomez, Flores & Jimenez, 1996) that

depends heavily on the field work (Punch, 1998) that is not experimental (Ponte, 1994) which is based on multiple data sources and varied (Yin, 1994)"[39]. And added that "it is the strong descriptive mark, associated with the fact that the researcher is personally involved in the study, which led many to associate the case study with qualitative research, what is however a misconception since the case study can also be conducted within the framework of other paradigms of research as the positivist or even the critic (Ponte, 1994; Lessard Territories, Goyette & Boutin, 1994; Punch, 1998), reason why some authors consider it as a mode of mixed research (Bisquerra, 1989; Gomez, Flowers & Jimenez, 1996)"[40]

Stake points out that "the case study is not an investigation based on sampling. You do not study a case for understanding other cases, but to understand the case itself". (Stake, 1995)[41]

Coutinho & Chaves (2002) add that for "Gomez, Flores & Jimenez (1996) a case study is still justified in another situation, its critical nature, i.e., the degree to which allows you to confirm, modify, or expand the knowledge about the subject which is being studied, thus contributing to the theoretical construction of that field of knowledge."[42]

However, one cannot fail to make reference to the general framework of analysis and the multiplicity of methods on serious games field of research. Mayer, Bekebrede, Harteveld, Warmelink, Zhou, Ruijven, Lo, Kortmann & Ivo Wenzler (2014) report that in order to assess

39 Translation from the original reference "o estudo de caso é uma investigação empírica (Yin, 1994) que se baseia no raciocínio indutivo (Bravo, 1998; Gomez, Flores & Jimenez, 1996) que depende fortemente do trabalho de campo (Punch, 1998) que não é experimental (Ponte, 1994) que se baseia em fontes de dados múltiplas e variadas.
40 Translation from the original reference "é o seu forte cunho descritivo, associado ao facto do investigador estar pessoalmente implicado no estudo, que leva a que muitos tendam a associar o estudo de caso à investigação qualitativa o que é todavia uma concepção errada já que o estudo de caso pode também ser conduzido no quadro de outros paradigmas de investigação como o positivista ou mesmo o crítico (Ponte, 1994; Lessard Hébert, Goyette & Boutin, 1994; Punch, 1998), razão porque alguns autores a consideram como uma modalidade de investigação mista (Bisquerra, 1989; Gomez, Flores & Jimenez, 1996)"
41 Translation from the original reference "o estudo de caso não é uma investigação baseada em amostragem. Não se estuda um caso para compreender outros casos, mas para compreender o caso".
42 Translation from the original reference "Gomez, Flores & Jimenez (1996) um estudo de caso está ainda justificado à partida numa outra situação, a do seu carácter crítico, ou seja, pelo grau com que permite confirmar, modificar, ou ampliar o conhecimento sobre o objecto que estuda, contribuindo assim para a construção teórica do respectivo domínio do conhecimento"

serious games, researchers should use mixed methods of analysis “evaluation data were gathered through mixed methods, mostly combining pregame and postgame surveys among the players, live or video observations, transcripts of after-action reviews and game results.” In figure 3, the authors identify the mixed methods of analysis on serious games:

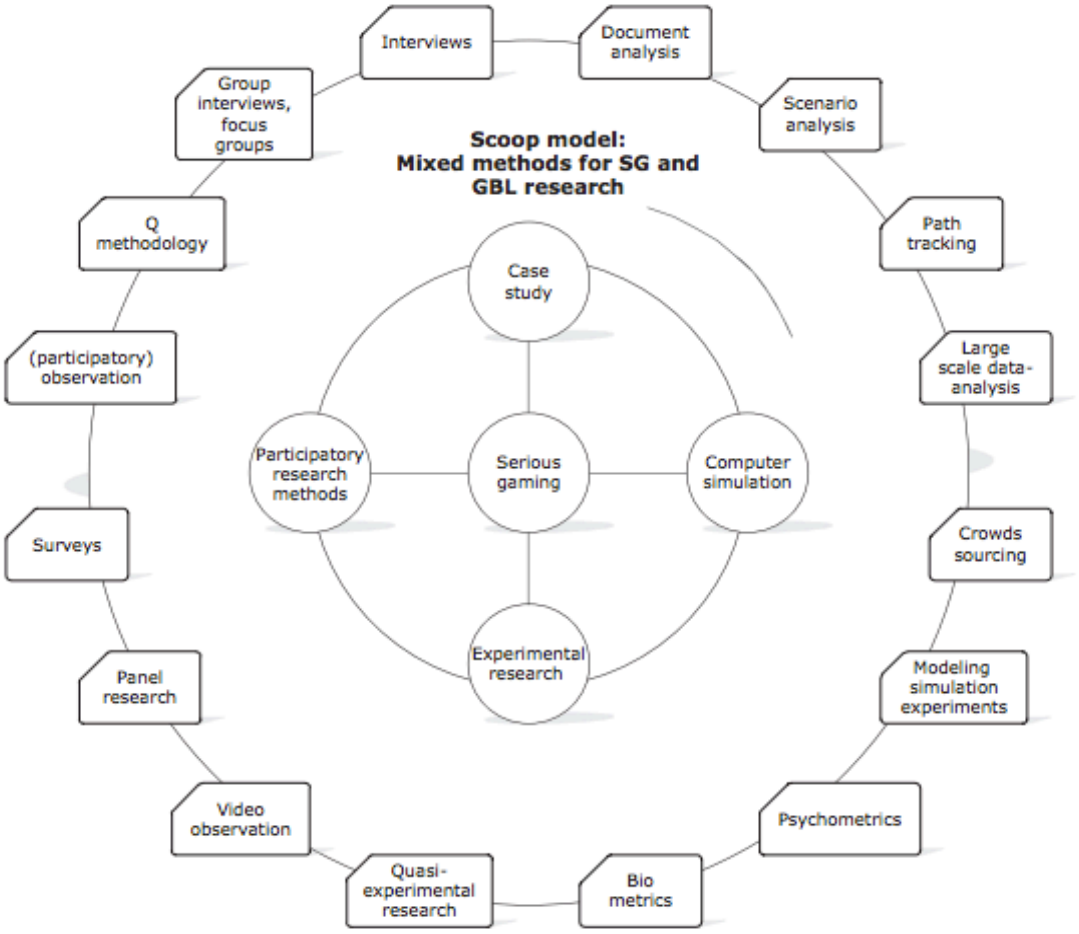



**Figure 5 - Mixed Methods analysis of serious games**

This figure shows some of the mixed methods to be used in the evaluation of serious games and how we can get results, being possible to analyze, as well, the convergence of methods in the framework of serious games. In regards, in this investigation were used: case studies, experimental research and surveys in order to analyse serious games.

It is equally important to understand the different stages of evaluation of a serious game. Mayer, Bekebrede, Harteveld, Warmelink, Zhou, Ruijven, Lo, Kortmann & Ivo Wenzler (2014), in figure 4, noted that are different characteristics when it concerns to the evaluation of serious games.

| *How* | | *What?* | *Pregame* | *In-game* | *Postgame* |
|---|---|---|---|---|---|
| Self-reported | Qual. | Personality, player experiences, context, etc. | Interviews, focus group, logbook. | Logbook, interviews or small assignments as part of the game. | Interviews focus group, after-action review. |
| | Quant. | Socio-demographic, opinions, motivations, attitudes, engagement, game-quality learning, power, influence, reputation, network centrality, learning satisfaction, etc. | Survey, quest., individual or expert panel | In-game questionnaires | Survey, quest., individual or expert panel |
| Tested | Qual. | Behavior, skills, etc. | Eg, actor role-play, case-analysis, assessment, mental models. | Game-based behavioral assessment. | Game-based behavioral assessment. |
| | Quant. | Values, knowledge, attitudes, skills, personality, power. | Psychometric, socio-metric tests: eg, personality, leadership, team roles, IQ. | Game-based behavioral performance analysis. | Game-based behavioral performance analysis. |
| Observed | Qual. | Behavioral performance of student, professionals, player and/or facilitator, others; decisions, strategies, policies, emotions, conflicts, etc. | Participatory observation, ethnographic methods | Video, audio personal observation, ethnography, maps, figures, drawings, pictures, etc. | Participatory observation, ethnographic methods. |
| | Quant. | Biophysical–psychological responses, like stress (heart freq., perspiration). | Part. observation, network analysis, Biophysical–psychological observation. | In-game tracking and logging, network analysis, data mining, biometric observation. | In-game log file analysis, network analysis. |

**Figure 6 - Different stages of evaluation of a serious game**

The researchers explain the issues rose in the different phases of a serious game evaluation, which aim to respond to items of various orders. To know:

- Before the game: socio-demographic data; level of gaming experience previously acquired; attitudes and motivation; specific competences; behavior; organizational characteristics.

- During the game: the performance in the game; how to play (gameplay), the experience during the game.

- After the game: the overall experience of game; satisfaction of the player; learning with the game.

After the creation of the objects for the case study, it was necessary to understand the guidelines of the assessment of the case study II. In this sense, it is intended to identify and explain the methodology used for the controlled experiment development in the case study II - Alpha Patrol serious game.

One of the most used models for the evaluation of serious games is based on the Kirkpatrick model. This model was conceptualized by Donald Kirkpatrick in 1994 and aims to make an assessment in four distinct levels of complexity: reaction; learning; behavior; and results. The assessment focuses on the initial expectations of the player torwards the serious game; the final opinion of all players; the acquired knowledge difference from starting point to the end of the serious game; the change of behavior of the player.

However, we do not consider this a complete model to be able to respond to the research hypotheses. So, for this case study - the serious game Alpha Patrol - we used the model for evaluation of serious games proposed by Savi, Wangenheim, Ulbricht & Vanzin (2010) which is based on 4 different models of analysis: the Kirkpatrick model (only the level 1 - Reaction); the motivational model ARCS; the game user experience; and the principles of Bloom's taxonomy. The authors report that the theoretical foundations of models can be analyzed in the table that follows,

| Characteristics | Theoretical References (model used) |
|---|---|
| Perceived by students | Level 1 of the model Kirkpatrick (1994) |
| Motivation in games | The ARCS model, Keller (1987) |
| User Experience | Models for assessment of user experience in games (SWEETSER; WYETH, 2005; POELS; KORT; IJSSELSTEIJN, 2007; GÁMEZ, 2009; TAKATALO et al., 2010) |
| Learning with games | Principles of Bloom's taxonomy (1956) and Model of Moody and Sindre (2003) |

**Figure 5 - Analysis Models**

To understand the students' perception and reaction, the authors used level 1 (from 4 levels) of Kirkpatrick's learning and training model. The other levels were not used, because they need at least 1-year experience to get results.

Savi et al. (2010) consider the fundamental role of motivation in the evaluation of a serious game. The use of the model ARCS (Attention, Relevance, Confidence, and Satisfaction) aims to use motivational strategies in educational materials (KELLER, 1987, 2009). When a student uses the serious game he/she creates expectations on the object. Thus, by asking questions about motivation we can assess that sort of issues.

To obtain a holistic evaluation of the serious game, we must take into account the user experience. The user experience is the interaction of the user with the serious game, and where the perceptions that result from the interaction are considered, for example, if it was easy to use, it was confusing, or if the product/game has surpassed what was expected (Tullis, Albert 2008). Savi et al (2010) used the models from Sweetser, Wyeth, (2005) Poels, Kort, Ijsselsteijn (2007) Gámez (2009) Takatalo et al. (2010) to understand the player experience in the use of a serious game. It should be noted that the models of these authors converge to consider: the concept of "experience" is difficult to be described and assimilated, and intend, therefore, to understand the user experience in serious games from the elements of interaction that are: fun, immersion, challenge.

In the latest theoretical reference from the same authors to create a model for serious games evaluation, it is necessary to assess learning/knowledge. Bloom (1956) and Moody & Sidre (2003) mention that any educational intervention must have well defined educational goals so that educators may have the criteria to select the methods of activities. For Moody & Sidre (2003) the educational objectives are defined as “the knowledge, skills and attitudes that students should have at the end of an educational activity.”[43] As such, Bloom (1956) created taxonomy with the aim of supporting the processes of design and educational assessment (CHAPMAN, 2009b).

Bloom’s taxonomy discusses the cognitive domain, the physical development, and attitudes. However, in this context, we will focus on the first three levels of Bloom’s taxonomy for the cognitive domain (of a total of 6 levels: knowledge; understanding; implementation; analysis; synthesis; and evaluation). (BLOOM, 1956). It should be noted that Bloom’s taxonomy is a structure that can be applied to plan, design and evaluate learning effectiveness (BLOOM, 1956; CHAPMAN, 2009b).

43 Translation from the original reference “os conhecimentos, habilidades e atitudes que os alunos deveriam ter ao final de uma atividade educacional”

Consequently, based on the proposed model, we list bellow the questions of the pre-test survey and the post-test survey, divided according to the phases described in the evaluation model of Savi et al. (2010) concerning educacional games

| | Survey before the application of the serious game |
|---|---|
| **Reaction** | • What are your expectations in relation to the game?<br>• In your opinion, will you be able to learn something new with the game? |
| **Motivation** | • Do you think the game will be easy or difficult?<br>• Do you usually use this type of games in the classroom? |
| **User Experience** | • Do you usually play games? With what frequency?<br>• What kind of games do you like the most?<br>• Do you usually play more on the computer, in the console, mobile, tablet? |
| **Learning** | • Did you know the theme of disasters already?<br>• Did you ever read a book about the disasters? |

**Figure 6 – Pre survey**

| | Survey after application of the serious game |
|---|---|
| **The Reaction** | • Did you like to participate in this project?<br>• Did you enjoy the format of the game?<br>• Did you like the look of the game?<br>• Did you enjoy the characters?<br>• Have you found the game easy to navigate and play?<br>• Do you think the information in the game was enough to move forward? |
| **Motivation** | • What was the level you liked the most and what was the level you least enjoyed. Why?<br>• Would you like to learn more about the topic?<br>• Did you expect the game to have more levels?<br>• Do you think the game's content is important?<br>• Do you think the game is helpful? |
| **User Experience** | • Do you think the game is appealing?<br>• Are you satisfied with the game?<br>• At some point did you wanted to quit the game?<br>• Do you think you improved your gaming skills throughout the game? |

| | |
|---|---|
| | • Do you think this game offers new challenges?<br>• Would you play this game again?<br>• Please indicate three strong points of the game.<br>• Please indicate three weak points of the game. |
| **Learning** | • Has the game helped you to reflect on the theme of disasters?<br>• Do you think it is helpful to use games in the classroom environment?<br>• Has the game added knowledge to which you had already?<br>• What were your main difficulties during the game?<br>• Was the game easy to understand and follow?<br>• Were the quizzes easy to understand?<br>• Did you learn some new content with the game?<br>• Do you remember the information related to the theme presented in the game?<br>• Can you understand better the themes presented in the game, after you have played it?<br>• Can you apply the issues related to the game? |

**Figure 7 – Pos- Survey**

# 4. CASE STUDIES

## 4.1 Conceptualization

In order to answer the research questions there were two possible solutions: choose within the existing examples in the market one or more serious games; or choose to use an original serious game. For our purposes, we selected the second hypothesis, since the doctoral student responsible for this thesis integrates a team of software development at the center of research in which she is integrated and one of the axes of research is the experimental study of serious games.

Therefore, all phases of the process - idea, conceptualisation, study of the state of the art, development and integration - were processes that have resulted in a set of serious games, required by the Portuguese Association of Insurers. It was a project with duration of 3 years, and which the main objective was to create a set of serious games to provide young people with digital active and enjoyable forms to acquire information on the function, functioning and utility of the insurance industry. The initiative aimed, on one hand, to provide correct information and perspectives on the essential of the insurer activity, and at the same time contribute to dilute some "clichés" supported in simplistic ideas that distort or caricaturize the system of insurance services.

The project was developed to test three hypotheses:

a) A significant part of the information consumed by young people of the second decade of the 21st century is conveyed by digital interactive systems;

b) Digital systems are not tight, they are spread through spontaneous networks of communication;

c) The undifferentiated use of computers, tablets and mobile phones as privileged vehicles of digital systems involve the adaptation of the message to different vehicles.

Within the research project accepted by the parties, it was determined the creation of a digital ecosystem that contains a set of games to which are inherent a subset of common concepts conveyed through informal learning strategies, which exploit sectors and subsectors of digital networks to generate formulas of exponential dissemination of values and concepts about the essential of the insurance activity.

Children and young people were determined as public-target, i.e. three age groups with well identified interests:

a) Children: 5-7 years;

b) Children: 8 -10 years;

c) Adolescents: 11-13 years.

The target groups are not tight, as they possess very distinct competences and tastes, and therefore several communicational strategies should be used.

There is, however, a common denominator that unites them: they like to play by gaming and like to game via consoles, graphic tablets, pcs and mobile phones, i.e. in multiplatform, so we can conclude that all target groups accept with ease several typologies of serious gaming.

The research objective was conceptualized in two phases: first, we describe the relationship between motor racing, accidents and insurances. To this game was added another theme – Safe House (robbed house theme). This first step was performed in an internal circuit: the research project has defined the implementation of two sets of games that in a first phase were analyzed internally by the research group who participated in it: the storyboard team; the

information architecture team; the design team; the 3D team; the digital content team; and the programming team.

In the second step, the game on disasters and accidents that have changed the course of the insurance history was tested and examined. The tests were performed with a class of 30 elements of the 7th grade at Filipa de Lencastre School in Lisbon.

It is important to define what was carried out for each of the stages proposed: in the first set of games, presented here as a case study I, we proposed to develop three games and three different solutions, whose strategy, elements and resources were diversified according to the age group to which these games were intended; in the case study II, we developed a game that had as objective generate interest in the three age groups. It was a game bases on the Isabel Alçada and Ana Maria Magalhães' book about *Natural Disasters*.

The construction and development of these case studies are fundamental elements in this thesis, and they arise as an alternative to analyze elements previously built by other entities. The path chosen was not the simpler, but we consider it the creation of technological elements to be an added value as base and support of a dissertation in Digital Media.

Also crucial to mention that the development of these games, i.e. the development of the "serious game" to design and develop a simple but strict model of game, in accordance with the evolution and mental capacities of the subjects from the three age groups above characterized, since the same representation of reality has very differentiated treatment. This involves variables that require differentiated forms of learning, given multiplicity of processes required for its resolution.

Consequently, we created the guidelines of this case study in the following diagram. The main objective is to answer to the research question: can serious games be an essential element to the learning process in a digital environment?

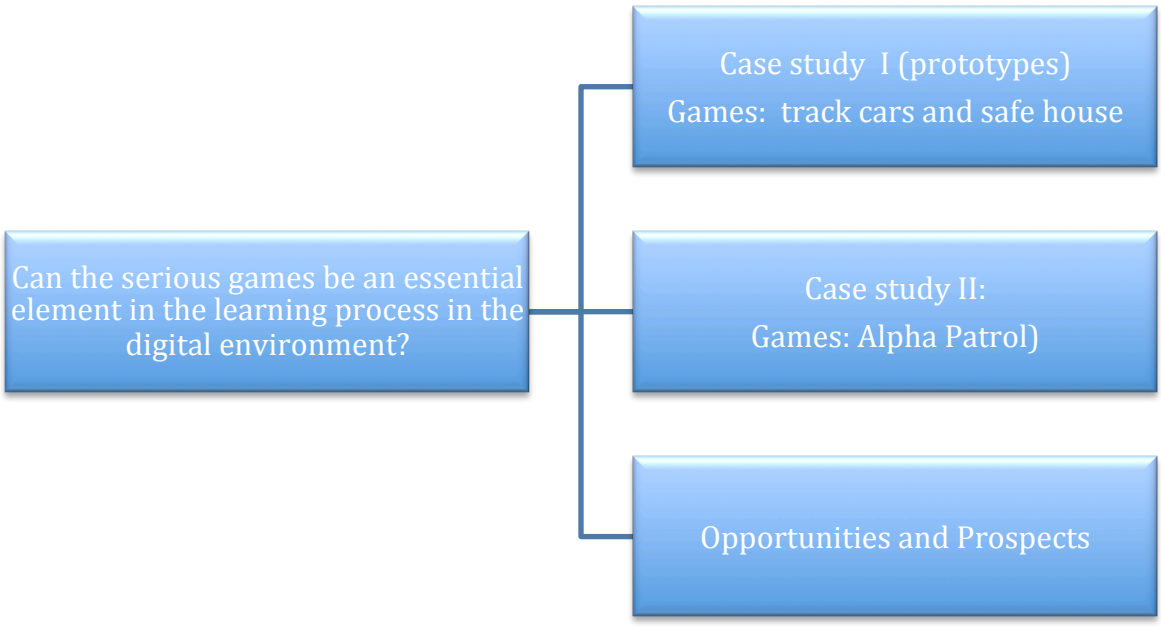



**Figure 10 - Conceptual framework of the dissertation**

### 4.2 Case Study I

Address the issue of insurance and insurance companies is not an easy task and minus intuitive, hence that before the research team drafted the plan to implement the project we considered necessary to ensure the funding that allowed the research center to be able to work. The Portuguese Association of Insurers decided to support the project presented and pre-settled the condition to have "children to young people" as target public. In order to achieve this requirement the research team, in which the doctoral student was integrated, chose themes that would be more pleasant to the target audience defined. The choice was motor racing. A simple, realistic theme, where issues related to insurance may be treated in as unequivocal. For the second game we chose the theme of Safe Home in coordination with the Portuguese Association of Insurers.

Different strategies were created for each game and each age group, in order to fulfill the objective and answer the problem: how can we create a game where the need for insurances is demonstrated?

In the first set, with the racing cars theme, three games were created: *Rodinhas e Companhia, Aerokarting* and *Fórmula RRR*. Figure 9 displays the page layout of the racing games on the Portuguese Association of Insurers' website. From left to right: the *Fórmula RRR, Aerokarting* and *Rodinhas e Companhia*. The three games have a brief description and multiplatform version access: web version or Apple and Google Play stores.


**Figure 11 – First set of games**

In the second set were created three games: *Perigo na Casa, Perigo na Quinta* and *Casa Assombrada*. Figure 10 shows the page layout of the games on safe houses on the Portuguese Association of Insurers' website. From left to right: *Perigo na Casa, Perigo na Quinta* and *Casa Assombrada.* The three games have a brief description and an access to the game in web version or both Apple and Google Play stores.


**Figure 12 – Second set of games**

### 4.2.1 Wheels and Company, Aerokarting and Formula RRR

In the phase of the concept creation, the research team in accordance with the Portuguese Association of Insurers chose the theme: motor racing. However, one of the problems was "how to integrate real insurance in games that can not be real?" For the game to be a reflection of the reality it would be necessary to use the same type of strategy simulation of driving cars (used by, for example, professional pilots of racing competition). To try to circumvent this fact, the games have a progressive difficulty degree: for little children, was developed a game with more basic and simple gameplay; in the intermediate game, some elements of fantasy were introduced to foster the imagination; in the game for adolescents, we introduced the use of more realistic elements with integration of the laws of physics. In this last case, the design team and the 3D team got inspiration in ball bearing carts, also know as soap carts. As the name indicates, these are carts with wheels, without engine, that move only due to the laws of physics.

The names of the games attempted to be reliable with the concepts that each transmited: Wheels and Company; Aerokarting; Formula RRR.

In the three games we used elements to entertain the players, but which if not avoided, penalize the player (by losing points). So, on one hand there are shocks among the cars and shocks with barriers on the road. On the other hand, there are animals. In these games, animals have a dual function: distract or hinder driving (one or more clashes means the loss of points), or being comic elements (with the different sounds).

In the game *Rodinhas e Companhia,* designed for children from 5 to 7 years, the objective was to create an appealing and attractive scenery with a simple gameplay. Functional, tactil and easy menus to immediately start the cars race. There is no choice of character: the personification of the car is the key element. The car is the character.

Figure 11 exemplifies the menu of the car choice. As this is a game for the little ones, the choice menu is quite simple. On the left side, it is possible to choose the car/character; on top, the settings and help, and in the lower part of the screen it is displayed the "Did you know?" area with tips and additional information on insurance.


**Figure 13 – Game Menu "Rodinhas e Companhia"**

Thereby, the moment of choice of menus is basically the track and car choice. Throughout the race, the player needs to move away from different elements that appear along the road. And also needs to move through different items to increase the time allowed to finish the race.

When it is finished, the screen displays an image of the winner celebrating victory or a message to encourage the player to continue to play and overcome the challenges.

**Figure 14 – Final screen "Rodinhas e Companhia"**

In the game Aerokarting and in the game Formula RRR the dynamics and the rules for the gameplay are similar in all things: in the main menu the player chooses the character, the car, the sponsor and the track where to play.

At the time of the character choice, the player can spend the points available to complete the costume: new clothes, new glasses, protective equipment, jewelry, helmets or shoes. Figure 13 shows the interface for this choice. There are blocked elements that can only be acquired when the player has gained enough points in previous races. Given that, for each successful race, i.e. without accidents, the player can earn more points and can later swap them by different elements.


**Figure 15 – Game menu "AeroKarting"**

On the next screen, the player can choose the sponsor: when choosing, the player should take into account what each sponsor offers by race finished without accidents; by race finished in first place; and by number of accidents that have happened. Each sponsor gives different values depending on the specificities mentioned above. This was considered fundamental, so that young people can acquire important information on the way insurances are operated. Moreover, this relationship is what justifies the integration of this project in the group of serious gaming.

Even before the race starts, the player should do the insurance he/she wants, i.e., should indicate the items he/she wants to hold for the race: the number of gathered animals, the number of accidents with obstacles and number of accidents with other cars. Figure 14 identifies the elements that the player can hold: shocks between cars, roadside obstacles and animals on the road.


**Figure 16 – Insurance itens menu**

But what characteristics differ from these two last games and the first?

In the game for children between 7 and 9 years, we play with the illusion and fantasy. In figure 15 we can observe one of the cars that has the shape of a light plane with wheels, but circulates as a car. Other "cars" are representations of dinosaurs, flowers, houses and beds flying, all with wheels.


**Figure 17 – AeroKarting race**

These cars perform different functions: slide, glide, fly high or fly with more speed. The objective of the race is to pass by checkpoints to achieve more points and finish the fast as possible. In the upper left corner there is always present the position of the player during the race.

In the game for the 11-13 years group the game play is different. The ball bearing carts still exist, but in this case cannot fly, nor plane. Players can only rely with the laws of physics to succeed in overcoming other players. The races have fewer laps but are longer, so the difficulty degree is higher (in relation to the other game). The choice of the player goes by 4 different options before the moment of the race:

A) Avatar: choice of a character and its specific wardrobe. This choice is associated with the personalities. There are psychological types: choleric, emotive, timid, introverts, bould, …, that generate different motivations that will give, in the end, the character of the avatar. The costumes and props are mainly adjuvants of each personality. The gallery of avatars oscillates

between the comic, the ludicrous and the "serious", respecting the genders issue, as well as the age group.

B) Car: the car that the user chooses has available a set of props, whose choice determines the value of sponsorships. This means that each prop has added determined a specific sponsorship with an attached value, but this is only revealed after all choices being made. Therefore, by choosing the car, the player is also determining the value with which the user will be able to make his insurance for the race. In figure 16 we can analyze the screen of the car choice with the different options on the left.


**Figure 18 – Car menu**

C) Race insurance: The player makes an insurance for the race with the value obtained from the car sponsors. This value allows the user to make a series of options on insurance. Without insurance the player cannot move in the race. Each player must have at least one item ensured to be able to play. Also in this case, learning about the world of insurance is done by "playing".

(d) The track: the user can choose the track depending on the desired scenery (as we can verify in figure 17). However, every track is always going down and it is necessary some expertise to be able to pass on all essential points to gain speed. These points are marked with a green symbol. Each race has a fixed set of straights, humps, twists and turns. The holes are variables that appear almost randomly; the removable barriers of protection may hamper the drawing of the curves and other difficulties. In each race there is a set of events that happen in random order: cows cross the runway, bales of hay, etc.

**Figure 19 – The track menu**

At the end of the race each player has access to their race score and to its overall score in the framework of the races made. I.e., the position is determined by taking into account the performance of the players who have previously made the race.

The winner of the race, the second and third ranked see the sponsorship increased, accumulate points in their insurances (bonus of being a good driver) and has more likelihoods for the following races.

It is important to emphasize all games were developed to be played on multiple platforms - pc, Android, IOS. They can be accessed through the web version or through the

applications shops. Each game is a unit by itself: there are no cross-references, collections or sagas.

In figure 18 we can observe an example of the construction of the poster for the game Formula RRR promotion: on the left side the draft and on the right side the final product.

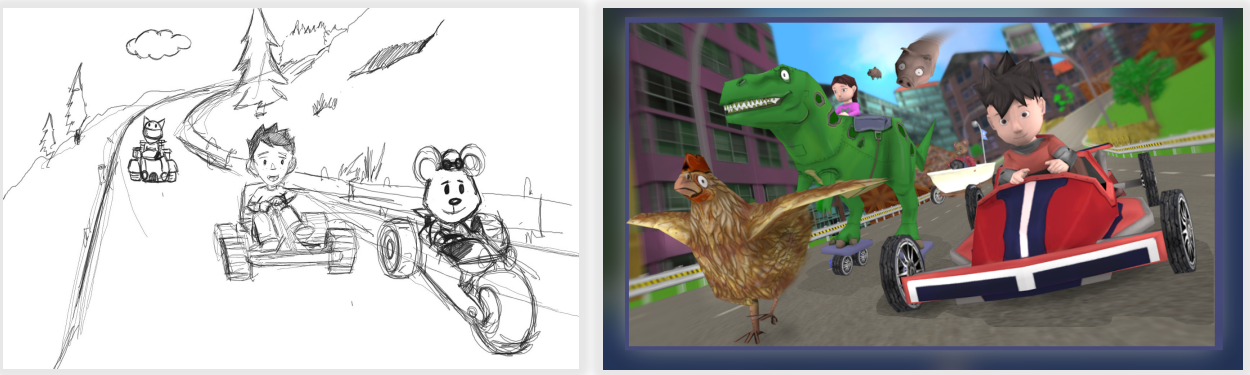


**Figure 20 – Poster of final game**

It is also important to highlight the common areas of the three games: the book and the section "tips to learn more about insurers". There is an integrated book with the game that deals with the history of insurance, as everything began, when and why. Whenever the player wants to access the book, he/she can simply stop the game and select the option of the book to learn some insurance concepts and what you can do with it. On the other hand, "tips to learn more about insurers" is displayed in the footnote on the game environment. It's simple phrases about the theme: why we must use insurance, numbers, statistics, curiosities. The objective of this section is to give small blocks of information which, later, the player will be able to remember or recognize in different situations. This section is presented by a grizzly bear clothed with different costumes to give greater dynamism and a humorous touch on the information presentation, as you can see in the figure 19.

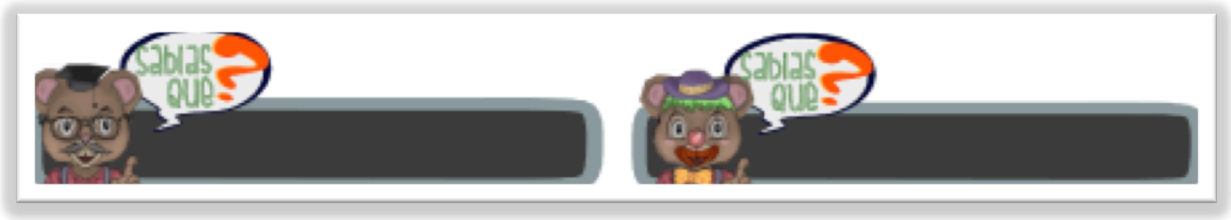



**Figure 21 - Menu "Sabias que?" (Did you Know?)**

This research project encompasses games, books and tips as a part of the strategy to acquire new concepts on the insurance industry using informal learning tools. In the figure 20, we present the book on insurance. The work was written by Isabel Alçada and Ana Maria Magalhães to the Portuguese Association of Insurers. The navigation is simple and can be accessed whenever necessary, as it can be seen.

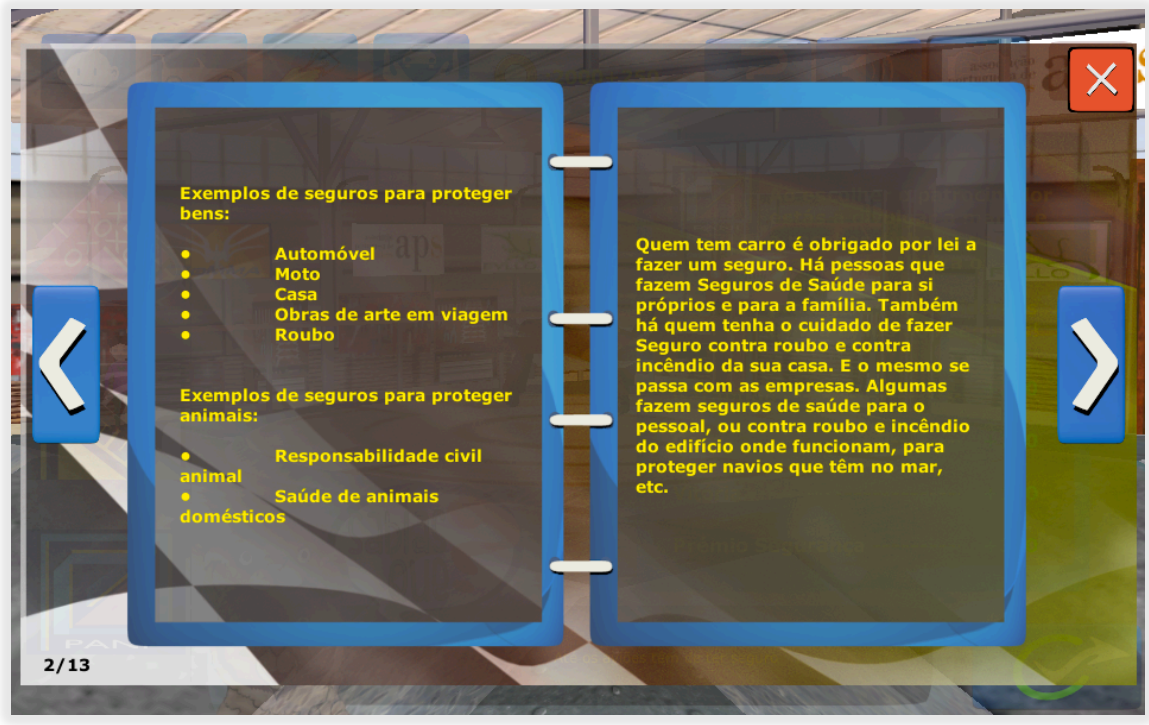



**Figure 22 – Book menu**

### 4.2.2 Danger in the House, Danger in the Farm and Danger in the Haunted House

In order to deepen the concept of serious games in the specific relationship they maintain between knowledge acquisition on insurance and the concept of games, it was chosen for the second game the theme of safe house. The objective was to create different sceneries within the thematic: a dolls house for the little ones; a farm environment with animals for the intermediate age group; and a haunted house for the older age group. The choice of the theme and the various perspectives of environment for the game are related with the interests demonstrated by each age range.

In the first game the gameplay is very simple, based on hide and seek. The main character is a cat that hides different items on the house. In figure 21, we can visualize the main screen with the game options. By clicking on the box, the player can access the different levels of the game. When the different levels are completed, divisions are filled with stars.


**Figure 23 - Menu "Perigo na casa"**

However, the user cannot click in all the items of the house, for example if the user clicks on the tap and leave it open this can cause floods, or by clicking on the spark plug it may cause a fire. These dangers mean to teach that inside the house there are several situations that can happen inadvertently. The gameplay is simple: the cat hides different items on several divisions of the house. The player has to try to find all objects to achieve the maximum score. As indicated in figure 22, the items that should be found are on the top line of the screen.

**Figure 24 - Game "Perigo na casa"**

The score is referred as a star that represents the player's performance. To choose the objects, the player must be carefull not to cause a fire or flood. This is a race against time to find the hidden objects. Figure 23 represents the final screen of the game, where score the is, as well as the time it took to play and the amount of times the user clicked without founding the correct objects (failures).


**Figure 25 – Final score board**

In the second game, as in the first, there is a time deadline to finish the game without damages. In the case of danger in the farm, the game aims to explore the farm environment and identify where the thieves who are not part of the initial scenery are. In figure 24, we can see two types of thieves who may find themselves in different divisions of the farm, either inside the house or in the stable.

**Figure 26 – Game thieves "Perigo na Quinta"**

The goal is to avoid the assault, as thieves can appear in different locations. In figure 25 we can identify in the upper left corner a map where the player is able to be guided and see where the various threats are.


**Figure 27 - Menu "Perigo na Quinta"**

The threats are of different order: thieves, tornados and wild animals (see figure 26). To identify the different threats the player should find them on the map that is located in the upper corner and thus navigate from room to room.


**Figure 28 – Animals from the game "Perigo na Quinta"**

The message of this game is based on the need to prevent serious threats and to make the user aware that is necessary to be attentive and preventive in order to be able to win the game.

In the third serious game, the player needs to go trough the house navigate with the help of the map in order to try to avoid spooks in the form of ghosts. In the main screen, as it is shown in figure 27, the player has indications on how to play, and whenever he needs, he can access the function "Did you know?" where he/she acquires useful information on the insurance industry.


**Figure 29 - Menu "Casa Assombrada"**

There are three types of ghosts and each has a specific characteristic in the act of destructing the house. The ghosts like destruction and confusion and the goal of the player is to arrest them in the act of vandalism. There are several secret paths the user can access to go through the Haunted House and to navigate more quickly between the different divisions.

In figure 28, in the upper left corner, we can see the map so the player knows where the ghosts are and prevent the destruction of the house. In the upper right corner the ghosts appear and they are distinguished by different colors. Each arrested ghost adds a point.


**Figure 30 - Menu "Perigo na casa assombrada"**

In the final screen, a message appears to inform if the player won, lost, the number of ghosts caught and how many accidents the player had when he/she didn't arrive in time to prevent the destruction.


**Figure 31 – Final game screen**

### 4.2.3 Challenges and Limitations

The two game trilogies, briefly described, intend to demonstrate the evolution of the process of conceptualization and development until the creation of the games.

In a general analysis, and taking into account that was the first foray of the Research Center in the serious games context, the challenges and the limitations found were of various kinds. These challenges set by the research constituted an important learning curve for both the doctoral student and project team. The relationship between what we proposed to accomplish and the final product is not always clear and only time, and a critical analysis, allow a dispassionate vision of the capital gains which the projects contains, and disregard some constraints such as a different idea from the customer, a difficult theme to address, or a short time frame, etc.

In fact, from the first trilogy to the second, time had a preponderant role: initially it was thought that after the construction of the first trio the rest would be more fluid. However, the challenges were the same: construction of new game mechanics, new designs (without any use of previous elements), new 3D elements, new scenarios, etc. Adding to these factors, how each theme was approached also constituted a challenge: to build a simple game is a difficult task. The apparent paradox results from knowledge of past experiences. To be able to incorporate new elements in games that was idealized as initially simpler turned out to be a complex task. It happened in the second game trilogy presented. While the metaphor of the bearting cart worked well from theory to practice, the same did not happen in the second trilogy. We refer to the idea of a dollhouse, reminiscent of some 90's games and the reference to the popular television series of the 80's Ghostbusters.

However, finding a metaphor that please the audience and the financier was one of the biggest concerns of the team. After the project review and analysis, we believe we could have done a much better job inspiration wise.

Here are some examples of what could be improved.

The guidance in the game - there was the need to put maps for spatial orientation of the player. But, what is often understood as an automatic gesture, may not be viewed in the same way by all players, because each player has different game experiences, as the gameplay culture is related with personal interests. I.e. what may be considered an easy perception for some may not be for others. The multidisciplinary team that builds a game must think as a gamer and may never cease to maintain an open dialog with the customer and perceive their needs.

Another limitation was the project dissemination: without a strong marketing machine to spread the news and an investment in line with the intended, the project was not accessed by the number of people who we had initially estimated. The placement of the games on multiple platforms, like Apple and Android stores was not sufficient to achieve the strategy. It is, however, important to remember that the games lifetime in application stores is scarce, for example, the game is only on the first browse page for two weeks, which limits the process.

In spite of the constraints described here, this research project was an important milestone for the development of future initiatives as concept prototypes, development and analysis for the case study II.

### 4.3 Case Study II

#### 4.3.1 Context

Alpha Patrol (in Portuguese Patrulha Alfa) is one more serious game developed by Research Center for Interactive Technologies in partnership with the Portuguese Association of Insurers. The creation and development of this game was the second phase of the project now under examination.

The team has reflected on the strengths and weaknesses in the first project, examined the learning curve, both individual and collective, and assessed to which extent it would be possible to create a booklet with anchors in the weft of a game.

The main difference in relation to the previous study case, resided in the starting point of the conceptualization of the game: not only existed a concept, as there was a book with the theme that was intended to address.

The book on disasters, which was the basis of the game, was written by Isabel Alçada and Ana Maria Magalhães, and explains how the disasters influenced the history of insurance. The purpose of the game is to relate to the main points of the book - the impact of disasters - with a platforms based game. To move forward in the game, some clues are provided, which also stimulates the player to check the book for more information.

In the game, the team is composed of two elements, Maria and David. Their mission is to observe the historical events that have marked the history of insurance. One day while watching the *Great Fire of London* they are surprised by giant robots that threaten to create greater chaos around them. To avoid chaos, Maria and David are accompanied by their flying robot - Alcid – who helps them. Alcid is beyond an android, it's a wizard time machine, which transports them between different eras. The game begins when one of the elements of the AlphaPatrol (Maria and David) is kidnapped.

Each user can choose the element of the team with whom identifies the most. That is, if the user chooses to be Maria, David is kidnapped, if the user chooses the character of David, Maria is kidnapped.

The game is split into three levels of difficulty and each of the levels is set in different scenarios:

- Level 1 - London. The great fire of London from 1666;
- Level 2 - Lisbon. The Lisbon earthquake of 1755;
- Level 3 - Japan. The Tsunami of 2011.

The progression of the dates of actual events was chosen to create the temporal and scenic evolution during the various steps/ levels in the game.

The following figure is the poster created with the game's main characters: David and Maria.

**Figure 32 – Game poster**

### 4.3.2 Implementation

At the time of conceptualizing the game, the name was thought to reflect on their development: Alpha and Omega, the beginning and the end of the alphabet. This metaphor was conceived to associate to the beginning and the end of a trip. Omega is a title recurrently associated with time (more famous for watches). Alpha because the team observes the events in first hand. Alpha and Omega are referred to the interference of time travel, in which future events influence the presence of the Alpha Patrol in the past, causing the idea of paradox.

#### 4.3.2.1 Narrative

The narrative begins with two characters: Maria and David, two time agents recruited by an insurers association in the 22st century, to form the Alpha Patrol. Their mission is to observe the historical events that have marked the history of insurance. One day while watching the *Great Fire of London* they are surprised by an army of giant robots that emerge from nothing and threaten them. (The figure 31 shows the screen of the characters choice, before the game starts)

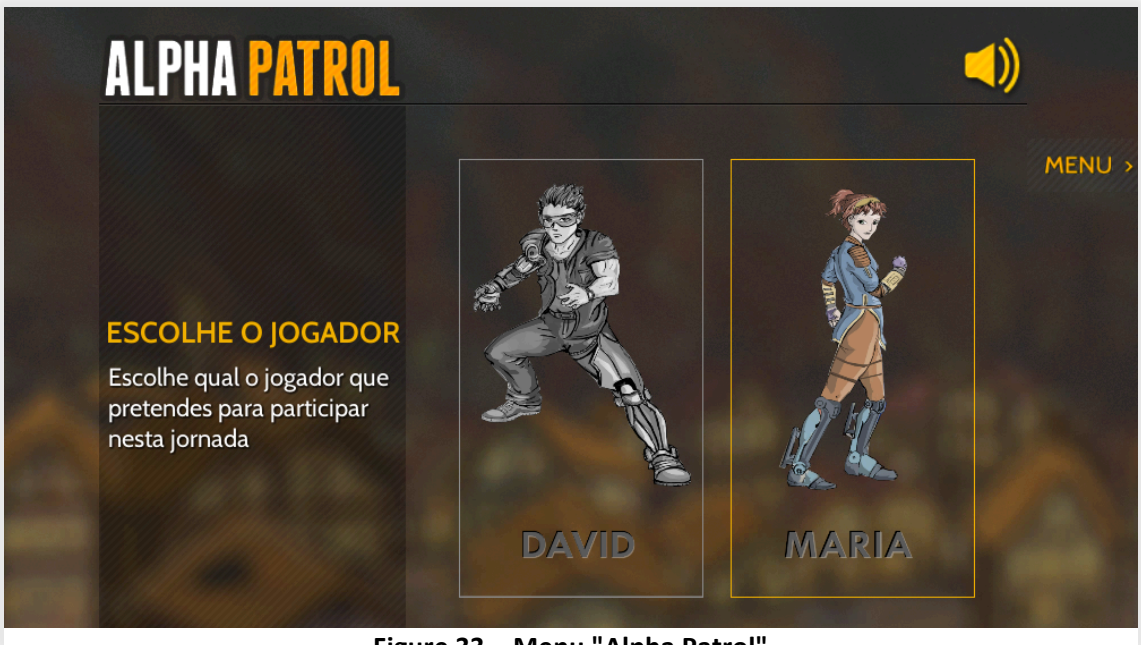



**Figure 33 – Menu "Alpha Patrol"**

Maria and David are accompanied by their small Flying Robot - Alcid. Alcid helps to explain the game controls and explains the narrative. Alcid is, in addition to an android wizard, a time machine that carries our heroes between the years and is in charge with their armors' customization. Therefore, the character of the robot is a Tutor that helps on the game development. In figure 32 we can see how Alcid transports the Alpha Patrol

**Figure 34 – Players transportation**

The player has the option to choose between Maria and David: the character that was not chosen is kidnapped by the army of robots. It is the first incident: the player has to survive and redeem the partner, for such, he/she should pass successfully the three levels, answering the questions asked.

When entering in the first game environment, the player perceives that the invading machines are immune to conditions of disaster, for example, in level 1, in the Great Fire of London, the machines are resistant to flame and monopolise the flames to repel the Alpha Patrol.

For the player to advance he/she must destroy the machines with a weapon only for robots; the machines are destroyed by shots of lightning or plasma, which are harmless to humans (we wanted to to annul any "realistic" violence associated to a certain type of video games).

**Figure 35 – Interaction between player and robot**

In this case, the robot receives a shock, is ought in parts, and the player receives a prize on the development or energy bar that is located in the upper right corner. This bar is always present on the main screen of the game, so the player can see his/her energy status to be able to continue in the game. In figure 33 we can see the interaction between the player and an invasive robot.

The character's costumes can be swapped in a simple menu of inventory (with the different parts purchased, extracted from the giant robots). This is crucial in the last level where the players will occasionally have to change clothes to reach their goal. Note that each robot that was annihilated will contribute to the growth of the loading bar (energy), which also enriches the complete outfit for each area.

Another important feature lies in the fact that the player may, along his/her route, find and save survivors in the rubble and thus receive bonuses per each person redeemed.

It is important to mention the predominant role that the narrative has throughout the game, as the narrative involves different levels. In the middle of the story the player gets new narrative developments, such as the explanation of the origin of the invaders robots, the explanation on the creation of Alcid (who discovers that the technology of robots invaders is the same used in his machine); the explanation of how Alcid escaped from the army of robots; Alcid's preference in travelling to the past instead of the future looking for answers; the existence of a leader on the invaders army of robots (called Omega).

At the end of the 2nd level the player loses Alcid: the robot observes the time flow left by one of the robot enemies and it's drawn to its future. The narrative goes in 3rd level, where the player discovers that Omega, the army leader is only a modified version of Alcid. In truth, Alcid has an objective to recreate all our history disasters, but in a more harmful way. The player has to confront Alcid and coordinate the robots army to spread awareness among the people on the earth to the disasters risks. Immediately the environment regenerates, the companions are reunite and everything ends well.

#### 4.3.2.2 Game Mechanics

This is mainly an action game with platforms with horizontal scroll. This game format intended to pay homage to the classic platforms games, bringing a new audience to APS games, the hardcore gamer. And it is definitely not a game that drives away the casual gamer, because there are two strategies to reach the end, a linear path in the levels and the exploration.

Some essential points were created in the game mechanics:

- Alternate paths and hidden treasures. The greater emphasis is given in the exploration of alternative paths and hidden treasures. The treasures are items that would otherwise be destroyed by the disaster and that the player collects. When he/she collectes sufficient treasures, the player can use this score to regenerate damaged outfits.
- Survivors. How many more survivors the player reddemes, the more he/she increases the life bar, prolonging survival in the game.
- Enemies' destruction. The player collects plasma shots for the weapon (the first item of the game) that are being left behind by enemies or spread on the scenery. Each destroyed/incapacitated enemy will contribute to the construction of the armour outfit. There is a progress bar on the screen to encourage the player; this bar is divided by small dashes. When the player destroys one of the enemies, he/she will receive a part of the armour. This armature is needed so the players can access areas that wouldn't be possible in another mode.


**Figure 36 – Narrative Menu**

In figure 34 we can observe one of the main screens where Alcid explains the history of the Great Fire of London.

#### 4.3.2.3 Armour / Suits

Armatures are an important constituent in the game, by its dimension of protection and player resistance. All armatures increase the player resistance and strength. If the player is without an armour or weapon, he/she can use body to body fighting, but will be more difficult to face the robots. Each armature bar has a shield that corresponds to the sum of the damage suffered in all parts of the armature.

In the interface/configurations menu (see figure 35) the player can change the armour and see their condition. Each armature suffers damage and may be regenerated or repaired through this quick menu with the activation of insurance.

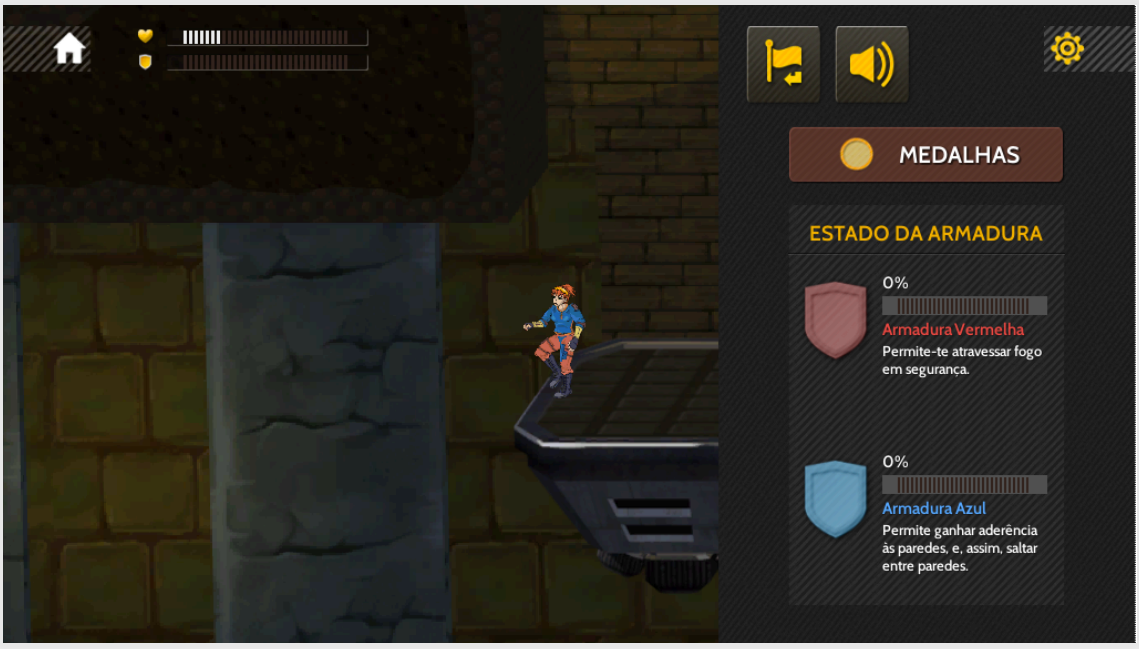



**Figure 37 – Armour Menu**

There are 3 main armours, corresponding to what the player is facing in the different levels (figure 36, from left to right):

- Fire armature. Resists the fall of glow debris and surfaces in flames.
- Wind armature. Allows the player stability in scenarios of tornados, protects against falling debris or wind. Also allows, when making the double jump, to glide for a few moments.
- Water armature. Allows the player to swim during an indefinite time (without drown). Gives speed and agility in aquatic environments. Hinders movement outside of water.

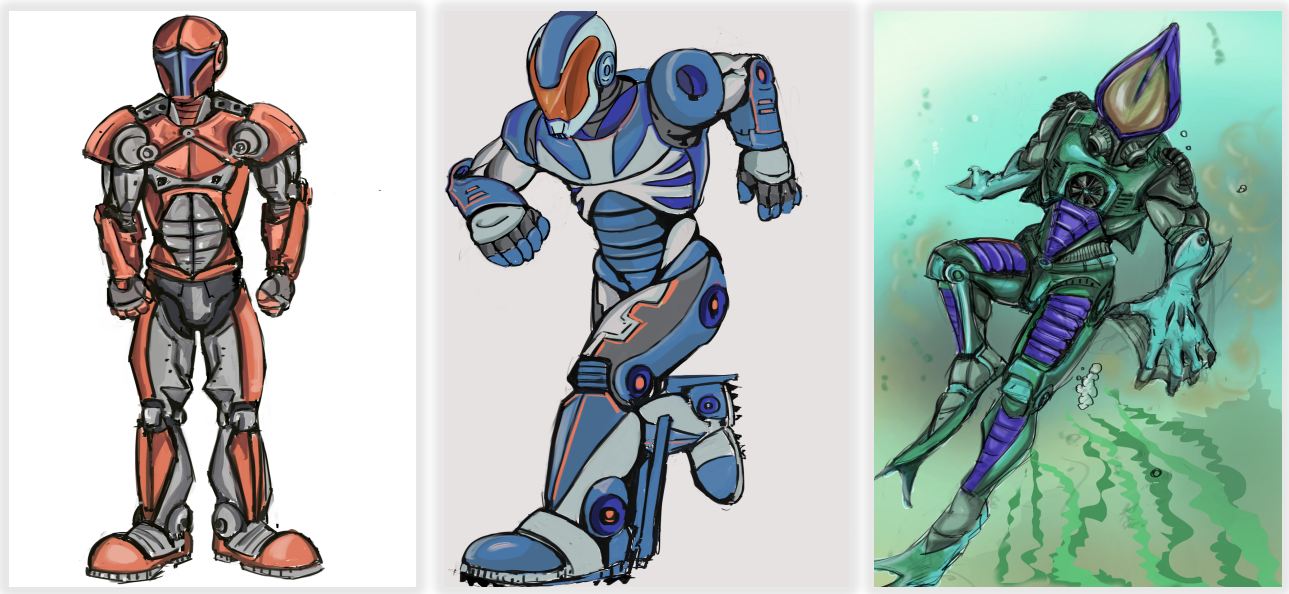


**Figure 38 – Fire Armature; Wind Armature; Water Armature**

#### 4.3.2.4 Technical Implementation

The game was developed in Unity using the 2D engine of the program itself. The characters are animated by clippings, i.e. each one of its members is flexible, making it viable their animation or replace part of the body by armour pieces.


**Figure 39 – First menu**

In figure 37, we can visualize the main screen, i.e. the first screen. In the case of scenery and also the small narrative introductions, they seek to emphase the tricks of parallax (or false 3D). In the introductions there is a shift of focus and the animated characters emerge from the scenery. During the in-game action the parallax intends to simulate a looming or point of leak.

The graphical style is a mixture of current animation series, as is the case of Ben 10 (one child that transforms into 10 monsters). And, on the other hand, meets classic games, using the aesthetic and conceptual elements of action games and adventure in particular Castlevania Megaman and Sonic.

In figure 38 we can view the instructions that are being given to overcome the challenges on the platform. These are simple instructions, with an intuitive design and with indications that a web player perceives without a problem.


**Figure 40 – Game instructions**

#### 4.3.2.5 Narrative Script

To better demonstrate the game dynamics, it is pertinent to describe the script of the narrative, step by step. In this way, we can perceive how the narrative, the history of disasters and the gameplay relate harmoniously to each other. Moreover, in the construction of the script, it was taken into account all essential elements of Isabel Alçada and Ana Maria Magalhães' book so the relationship between the history of insurance, accidents or disasters, was clarified by the narratives in the book. We believe that this is the only way the serious game concept can be applied at this stage of the project: the game is a pretext for the player to look for additional information for the development of the game, but central to the very concept of the game itself. In fact, this was the aim of the APS that financed the work: to post the history of insurance and teach, both through the book and the game, how insurance approached disasters and the way to compensate partially or fully the injured.

The following script, inspired by the work of Ana Maria Magalhães and Isabel Alçada, is of the authorship of the research team of the project.

*Level 1 - The Great Fire of London*

The travelers of time appear on a terrace of a building on the outskirts of London, Alcid, robot time machine hangs over the couple and contextualizes the on the event.

Alcid

Today, September 2, 1666, is the first day of the fire of London! The baker Thomas Farriner forgot to erase the oven where cakes cooked the bread and was to pour. Three hours later the building, located in a narrow street in the center of London, call Pudding Lane, caught fire.

Maria

In the school, the Teacher spoke about the fire. There were 3 days in which nobody was able to dominate the fire!

David

Yes, and incredible as it may seem, the number of deaths was relatively low.

Alcid

Truth David! Only 6 deaths were recorded, something unprecedented in a catastrophe of this magnitude.

*There are several outbreaks of light by scenario (in the background) as if they were portals of time)*

David

Look!! Technology of the 22st century, it seems that there are other travellers of time by here.

Maria

And does not pass unnoticed.

*(In front of the 3 comes one of portals, the interior leaves a little larger robot that a human)*

Alcid *(flying toward the robot)*

Who are you? What are you doing here? Identify.

*(The invading machine fires a flurry of shots lasers and reaches alcid -side, the small automaton is thrown backwards).*

Alcid

My  Hiperturbínio reactor is faulty. Error! Error!

*(The Robot appears in the direction of the player, gives a first tutorial in which the player has to face the enemy, struggling or fleeing).*

*After this confrontation, the other character (Maria or David according to selection of player) will be kidnapped by robot attacker, disappearing in a blue portals.) from this moment the player enters the game.*

Alcid

My system is faulty. We will try to follow in the footsteps of them to see the source of the problem.

Player

But what interest in interfering with historical events? Abduct people? Create further confusion?

Alcid

I detect a very strong signal in the opposite direction. Is the other side of town next to the bridge! Let us!

*The player will follow multiple paths along the path, or choose the rooftops, soil or underground through the catacombs and cellars arranged along the city. Alcid explains, always, the tutorial on the keyboard of your computer.*

*(to reach the end of the first level, the player must follow the tracks of Alcid)*

Alcid

We are in the midst of the fire zone! Attempts to save the maximum number of persons and obtain relevant information on the fire to get out of here!

Player

Information? Are you talking about what Alcid?

Alcid

We must find out who is behind this! And if an android wizard as i, then precise some replies to activate the time portal.

Player

You are talking about a navigation computer in the form of quiz?

Alcid

We are very predictable machines, are we not?

*(appear different situations with information on the on-screen text along with small quizzs cénario to which the player should respond correctly to advance).*

*(halfway through the player gets the armature of fire)*

Alcid

The armature of fire, it will protect you against the dangers caused by the scene you're in. To activate simply click the tools menu and choose the armature red.

Player

Finally I can pass through areas in flames!

*(The player arrives to the zone of the Tower of London)*

Alcid

You have to destroy that machine of temporal vortices, so you can only move forward by the portal and travel until the next season. You can!

*Level 2 - Earthquake in Lisbon*

Player

Alcid, do you know where we are?

Alcid

Yeah! Lisbon, the beautiful Lisbon.

*(feel an earthquake)*

Player

The route that was planned by attackers led us to another catastrophe.

Alcid

According to my information, we are in the earthquake of 1755. This disaster has had a considerable number of victims. Caused, mainly, by the drop of wreckage and by a tidal wave.

Player

Alcid, we will stay there again!

*(The player reaches the hole where is the generator of portals)*

Alcid

The next generator of portals is surrounded the guards, we have to be quick because when the tsunami arrive in a few minutes all this area is under water.

*Level 3 - Fukushima, Japan*

*(The player anything until the land and gives the dialog)*

Player

Finally, back in the 21st century!

Alcid

The events of disasters are in some way related; there was an earthquake and a tsunami of great intensity.

Player

Where are we?

Alcid

According to my graphic analysis and spectral we are in 2011 on the coast of Fukushima, Japan.

Player

I remember my parents speak of this earthquake, it was when the United States and Japan have created robots to contain the destruction within the central, was not?

Alcid

Very well!! Great advances in artificial intelligence were data in this period; much of me was born in Fukushima. Something tells me that what we want is within the central.

Player

But I have to use another armour, right?

Alcid

So, dear friend! The armature blue allows you climb the walls with fairly easily.

*(Outcome of the narrative: Alcid and player arriving to the room where a robot is, at his side the other player kidnapped with a portal on top, fixed in time)*

Boss

Welcome to the central Fukushima.

Alcid

Who are you? Identifies youself! I don´t know your model.

Player

Alcid… its you?

Omega

Yes, this was my name but can call me Omega. I knew that sooner or later would cross me with past versions. It was only a matter of time...

Alcid

I? How? Why?

Player

Something bad happened in the future, something which has suddenly seemed Fukushima a minor problem.

Omega

Yes! When the seas increased, the land and the volcanoes urrou wept, we machines, were the only ones to take decisions. The world governments have lost the strength. Was in the request the impossible, that ye livrássemos the larger of disasters.

Alcid

But the water, the fire, the washer and the radiation were excessive risks for a land so ill.

Player

Then knowledge distribute the evils not by space but by the time, in disasters that experienciaste in our company. In these disasters the risk would be poured through portals.

Omega

And my machines were certifying that no one survived, until thou shouldest ruined my plans.

Alcid

With my help! I do not know how I was capable of such a thing, I become a monster.

Player

We will defeat it together, Alcid!

*(Struggle. Alcid evil is defeated and the other character kidnapped frees-if the portal)*

Player

Was the Alcid behind the invasion of the machines but because thou it has kidnapped then?

Character redeemed

The Alcid of future knew that after all there crimes had no way to continue living with himself. The abduction was a way of obtaining the punishment and ensures that your version of the past would bear witness to all. Thus avoiding the consequences.

Alcid

Already I witnessed too by today.

Player

It is good that it all ended!! Shall we go home, my friends?

(The End)

#### 4.3.2.6 Game Quiz

An essential aspect of this game is the quizzes: small multiple-choice questionnaires that allow the player to move forward in the game and get the badges related to the question/answer system.

Several are the quizzes present in the game (see figure 39). To be able to respond correctly, the player must be aware of any information referred by the population throughout the game. This information is given by inhabitants and is crucial to respond correctly and, with a correct answer, go forward.

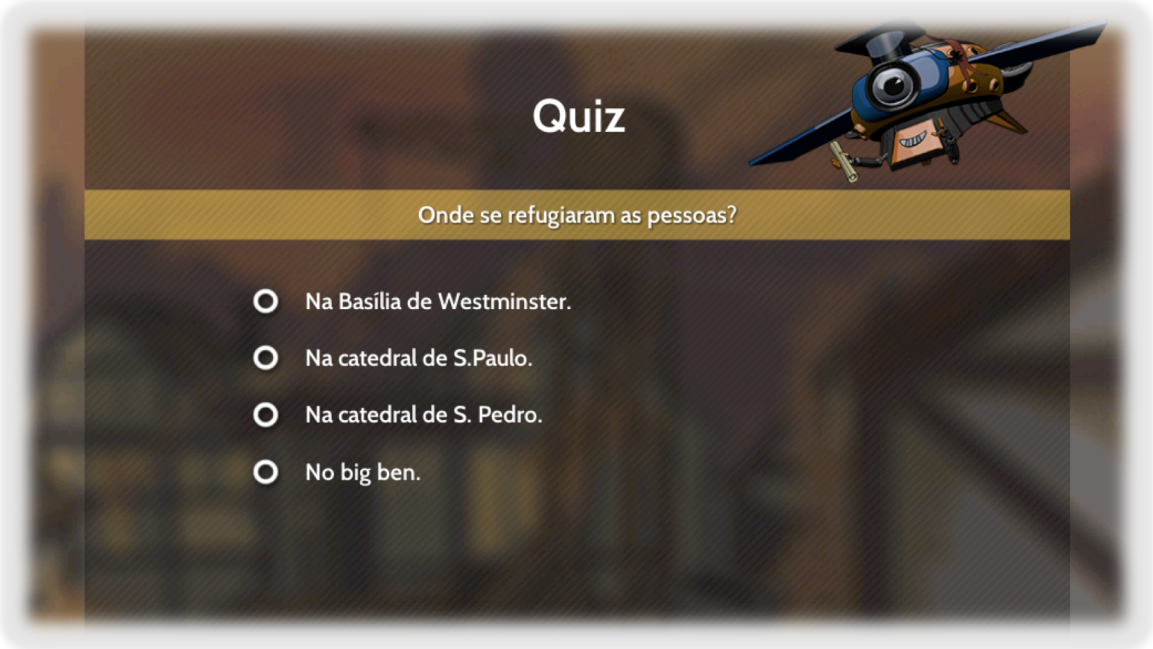



**Figure 41 - Quizz**

To a better understanding, we consider essential to describe the different quizzes that appear throughout the game.

In level 1, all questions are related with the great fire of London and the history written by Isabel Alçada and Ana Maria Magalhães in the book that came with the game, a strengthening aspect, as already explained, to consider this a serious game.

1. Where the fire has occurred?

- In bakery products
- In pastries
- In the tea house
- At the butcher

2. What is the reason of the fire spread?

- The Lord Mayor has not allowed the demolition of houses
- The Lord Mayor authorised the demolition of the bakery only
- The Lord Mayor died

3. Where people fled?

- In the Basilica of Westminster
- In the cathedral of S.Paulo
- In the Cathedral of St Peter
- In Big Ben

4. Who organized the fire-fighting?

- The King Charles II
- The Duke of York
- The baker
- The Lord Mayor

5. As it was called the Court created by the State?

- Court of fire
- Court of fire
- Court of Security
- Court of London

6. In the first insurance against fire, which was the protection, cover?

- Only the boxes provided
- The entire city
- The houses that had insurance and the houses of the neighbors
- The houses that did not have insurance

In level 2 the questions are related to the earthquake in Lisbon.

1.In what day did the earthquake in Lisbon?

- 5 October 1755
- 1 November 1757
- 1 November 1755
- 5 November 1575

2. Where do the people fled?

- To Cascais
- For the river Tagus
- To Almada
- The Castle of São Jorge

3. Where was the epicenter of the earthquake?

- In the Atlantic Ocean to the south of the Algarve
- In the Atlantic Ocean, north of the Algarve
- On the beach of Lagos in the Algarve
- On the beach of Albufeira, Algarve

4. As it were called the first house in insurance, in Lisbon?

- Home insurance

- Insurer of Lisbon
- Insurance and company
- The insurance company

5. Those who organized the reconstruction of downtown Lisbon?

- King D. Carlos
- S. Jorge
- Marques De Pombal
- The house of insurance

6. Where to fled Jácome Ratton and his family?

- For the river Tagus
- The Castle of São Jorge
- Not fleeing, stayed at home
- For Alfama

In level 3 the questions were about the disaster of Fukushima, in Japan. Unlike the previous levels, this only three questions to the player. As this is the end of the game the objective has been to give center stage to the gameplay.

1. When the tsunami occurred in Japan?

- 11 March 2011
- 12 March 2012
- 11 March 2010
- 11 February 2011

2. What exacerbated the tragedy?

- The central bus station of Fukushima
- The central train station of Fukushima

- The nuclear Fukushima
- The plant tissues of Fukushima

3. How many reactors exploded?

- 4
- 5
- 2
- 3

The combination of these elements intended to provide an evaluation on the level of concepts and situations that the player has managed to get hold of "in some ways games are polar opposites of more formal forms of assessment: one of the strengths of games is allowing students to make mistakes, learn from them, and try different approach – without fear of being monitored or assessed as they play. (…) In-game assessment has been recognized as useful tool, and has already been embedded within some existing learning games" (Moseley, 2014).

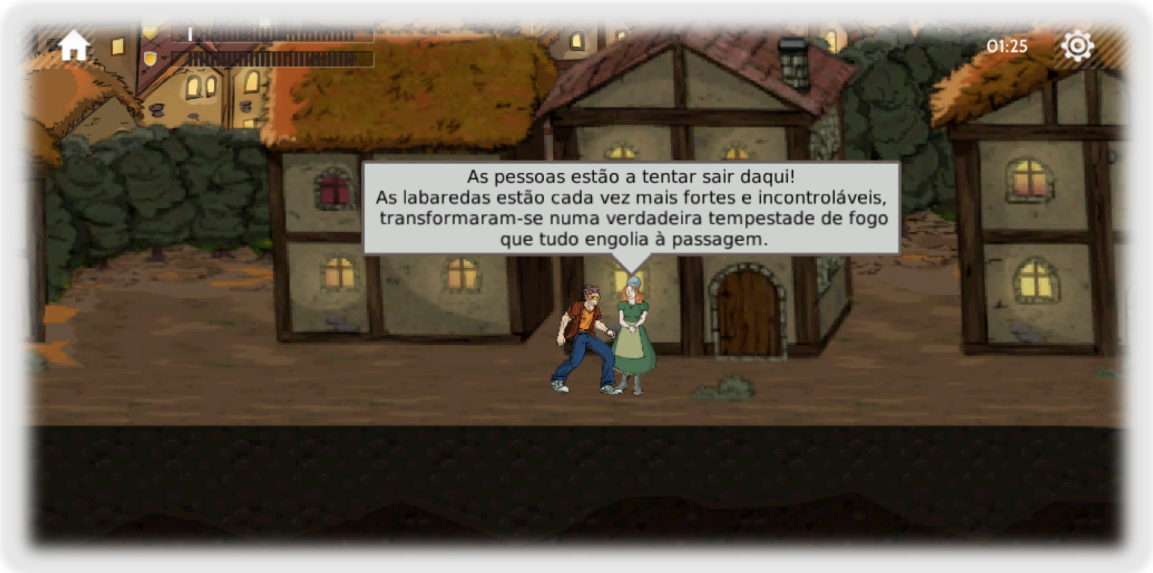



**Figure 42 – Game narrative**

Moseley (2014) notes, further, that these elements - the quizzes - used separately do not get the same result. Separate elements without being integrated into a strategy do not create a game. The strategy in this game, passes through the acquisition of information, which

can be removed either by the robot Alcid, either by the different characters who must be rescued by Alpha Patrol, in order to conclude with the success all stages of the game. Moreover, in order to reach the ultimate goal it is fundamental to read the whole book.

#### 4.3.2.7 Learning Badges

In the construction of a game are several characteristics that may be created and added.

The badges work by learning objectives, i.e., in the badges menu can we identify the badges available and what the player should do to get them. Therefore, the medals are of different categories, which recognize different skills of various: exploration, security, speed, combat and knowledge acquired. This is once again essential for this game to be integrated in the serious game group.

There were created 49 learning badges for this game. For the player to achieve the badges he/she should follow the indications. The following table (figure 41) explains what the player should do to achieve each medal:

| Learning Medal | What to Do |
|---|---|
| The restless | Give 5 hops |
| The Patient | Spend 2 minutes at any level of the game without doing anything. |
| The Very Patient | Spend 10 minutes at any level of the game without doing anything. |

| | |
|---|---|
| The incredibly Patient | Spend 30 minutes at any level of the game without doing anything. |
| The Without life | Spend 2 hours at any level of the game without doing anything. |
| The does not stop quiet | Give 50 hops |
| And who do not jump is not of the team! | Give 200 jumps |
| Premium Nelson Évora | Give 500 jumps |
| Where there is no smoke fire | Achieve the armature of fire. |
| They have sown the wind shall reap the whirlwind | Achieve the armature of wind. |
| Puts the wax, takes away the wax | Attack 20 times without weapon. |
| Young grasshopper | Attack 80 times without weapon. |
| Karate Kid | Tackle 250 times without weapon. |
| Kung Fu Panda | Tackle 400 times without weapon. |
| Soldier | Shoot 12 times. |
| Sargeant | Shoot 30 times. |

| | |
|---|---|
| Lieutenant | Shoot 60 times. |
| Lieutenant General | Shoot 150 times |
| The defender of the earth | Destroy 1 enemy |
| Steven Seagel | 5 Destroy enemies |
| Chuck Norris | Destroy 20 enemies |
| Terminator | Destroy 50 enemies |
| Treasure Hunter | Find 2 treasures |
| Explorer of maps | Find 5 treasures |
| Pedro Alvares Cabral | Find 9 treasures |
| Vasco da Gama | Find 18 treasures |
| John Indian | Find 27 treasures |
| Even now started | Conclusion of the first part of level 1. |
| London is already | Completion of level 1. |
| Smells well, smell of Lisbon | Completion of level 2. |

| | |
|---|---|
| Domo arigato Mr Roboto | Completion of level 3. |
| Tekken the | Take more than 4 minutes to finish a level |
| Zzzzzzzzzzzzzzzzzz | Take more than 10 minutes to finish a level |
| Obikwelo | Take less than 4 minutes to finish a level |
| Usain bolt | Take less than 2 minutes to finish a level |
| The incredible flash | Take less than 1 minute to end a level |
| The Pacifist | Ending a level without destroying more than 2 enemies |
| The Hippie | Ending a level without using the weapon |
| Poor in gold but rich in dreams | Ending a level without catching treasures |
| The Cult | Set in 1 quiz |
| The ensured | Set in 3 quizzes |
| The Responsible | Set in 4 quizzes |
| The Intelligent | Set in 6 quizzes |

| | |
|---|---|
| Note Maximum | Set in 15 quizzes |
| Irresponsible | Err 2 quizzes |
| I will draw your Guardian | Err 15 quizzes |
| The Salvador | Redeem 2 people |
| Freedom | Redeem 5 people |
| Mother Teresa of Calcutta | Redeem 15 people |

**Figure 8 – Learning badges**

These badges have as objective to recognize competences, “digital badges are a portable way to recognize achievement; any organization, application, or platform can easily issue and display them. And organizations that issue digital badges increase their potential impact by reaching new audiences and providing learning opportunities that can be recognized.” (Finkelstein et al, 2013)


**Figure 44 – Learning badges**

In figure 42, we find the screen of the learning badges with a description. The use of these custom badges may help to improve the skills of each player. However, it is noted that badges may recognize the good skills and also recognize the difficulties of the player regarding the type of game played. For example, if the player takes a long time to a win a level or miss the questions proposed. In this sense, the learning badges can be used for to study if the player can or should improve his/her performance in the scope of the game and the set of knowledge acquired in the game course.

### 4.3.3 Controlled experiment "Alpha Patrol"

A controlled experiment with the use of the serious game “Alpha Patrol” took place in School EB 2, 3 Filipa de Lencastre in Lisbon. The class, chosen randomly, was the 7ºA with 30 students: 18 students were female and 12 male students. However, and as the experience took place in the School Library, 4 other students wanted to join the experience: 4 male students from class 7ºC.

**Figure 45 - EB 2,3 Filipa de Lencastre School**

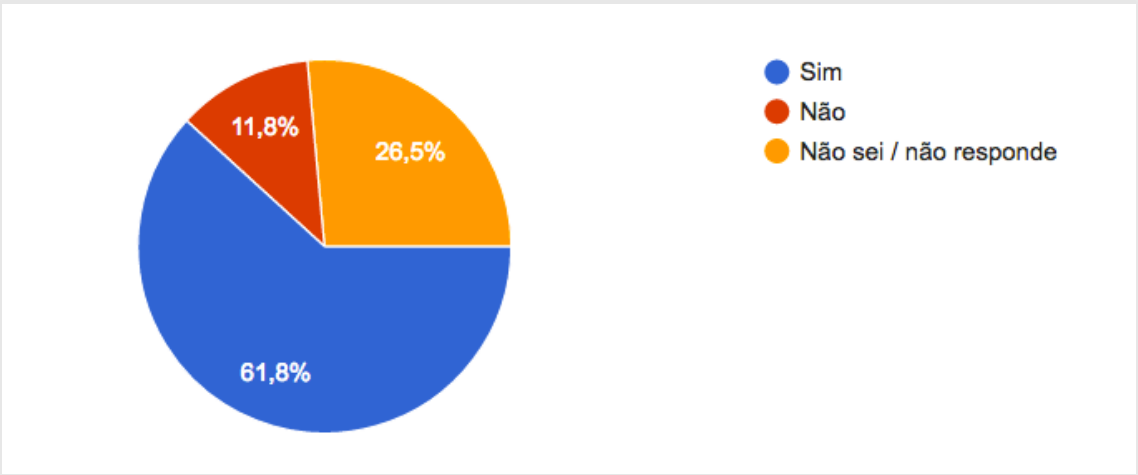
First, we asked the students to fill, individually, the original inquire on expectations, game habits, prior knowledge on the subject and the use of games in the classroom context. It was a short survey with only 8 mandatory answers required.

After the game – it was used an offline version of the game with the levels unlocked so they could have a preview at the entire game – the students responded to the final survey. This survey, filled out individually, aimed to analyze what they had learned, their general thoughts on the game and the relationship they established with the professors Isabel Alçada and Ana Maria Magalhães' book. The final survey was a little more extensive: 30 questions - 29 compulsory and 1 free response question (and not compulsory) for comments and suggestions.

#### 4.3.4 Presentation of results

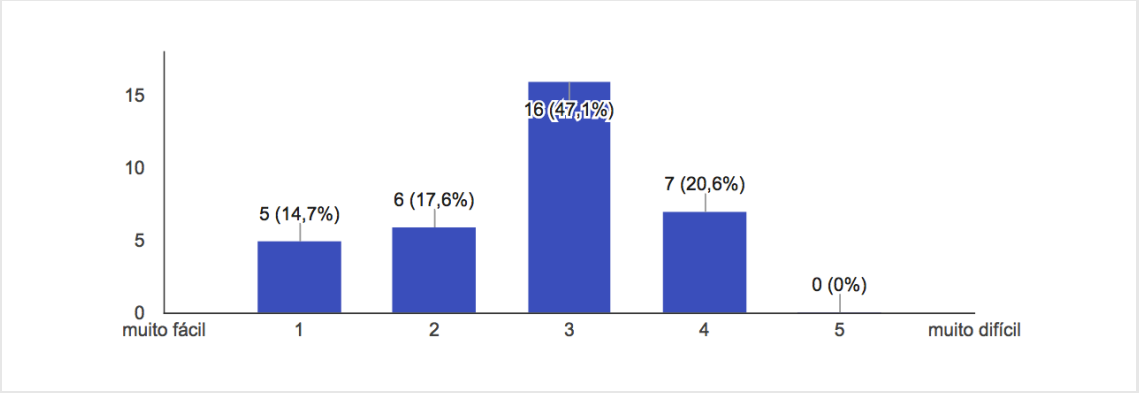
This chapter presents the surveys results of the controlled experiment referred and described above. It should be noted that all results are based on the 34 survey responses (N=34).

To the question posed in the context of the reaction, about "Do you think you'll learn something new with the game," (N=21; 61.8%) answered yes, (N=9; 26.5%) answered that they did not know (or rather not answer) and (N=4; 11.8%) replied that they believed they were not going to learn anything new with the game.



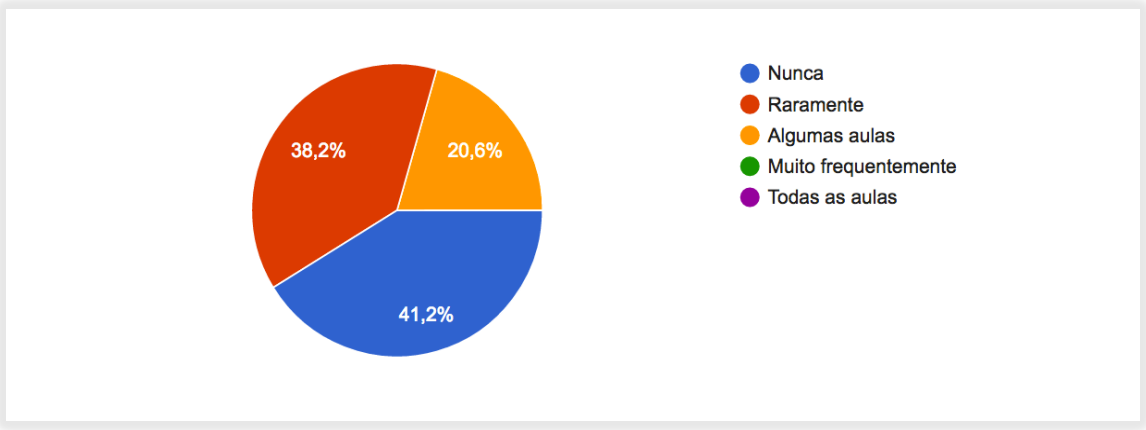

**Graphic 1- Do you think you'll learn something new with the game?**

When questioned about the ease or difficulty of the game, on a scale of 1 to 5, the majority of students chose to stay in the middle, between the easy and difficult (N = 16; 47.1%). The remaining percentage was between the very easy (N=5; 14.7% + N=6; 17.6%) and a little more difficult (n = 7; 20.6%) than the average indicated.



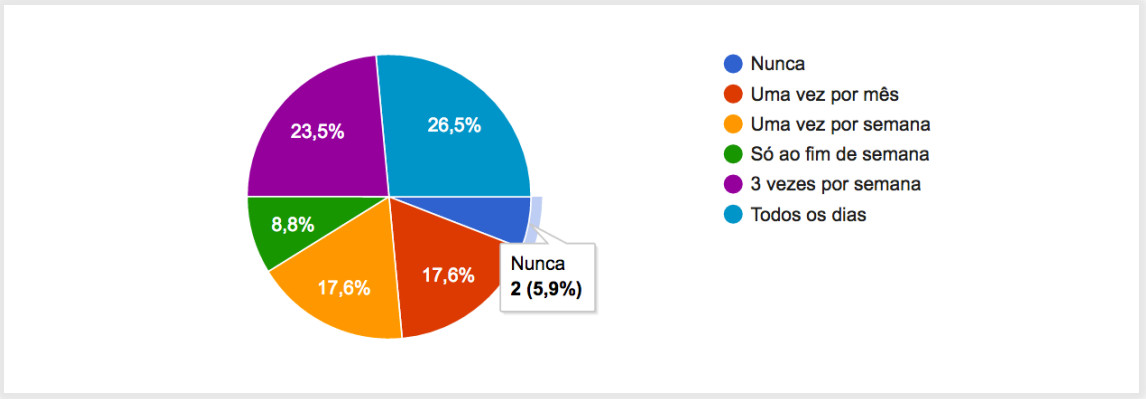

**Graphic 2 - Ease or difficulty of the game**

To the direct question "Do teachers often use this type of games in the classroom?" from the five answer types available, three prevailed: (N=14; 41.2%) reported that they had never used or do not often use games in the classroom; (N=13; 38.2%) indicated that rarely do teachers use games in the classroom context; and (N=7; 20.6%) reported that in a few classes teachers used this type of games in the classroom.



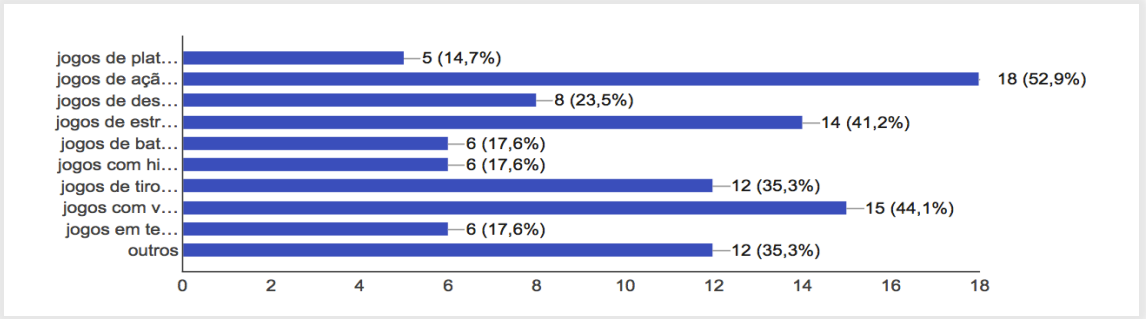

**Graphic 3 - Do teachers often use this type of games in the classroom?**

To analyze the frequency with which they usually play, the respondents have scattered their responses. N=9; 26.5% responded that he/she plays every day. N=8; 23.5% responded that he/she plays 3 times a week. The "once a week and once a month" answers had the same number of reactions (N=6) 17.6% each corresponding to 6 answers. Only 3 (N=3; 8.8%) of the respondents reported that he/she only plays at the weekend. And only two of the respondents replied that he/she never plays (N=2; 5.9%).



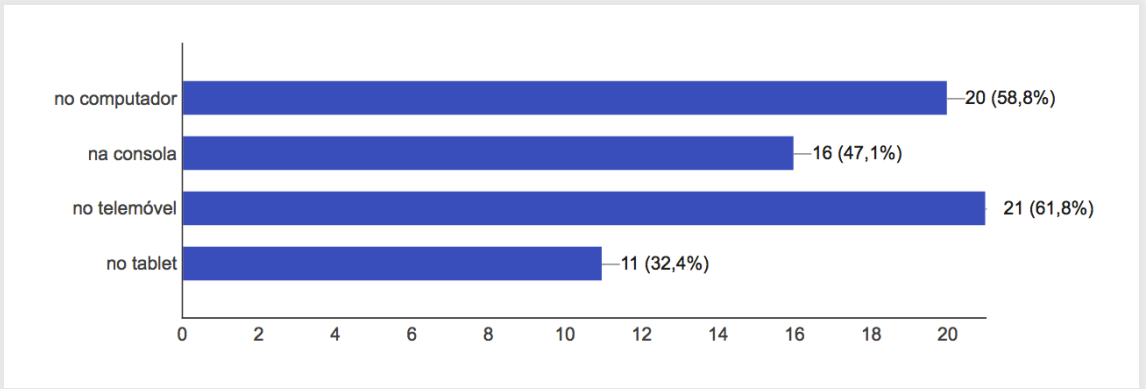

Graphic 4 - Analyze the frequency with which they were playing

To the question to indicate what type of games they like to play, (N=18) 52.9% responded action games and adventure. 44.1% (N=15) responded multiplayer games, with 41.2% (N=14) refering strategy games. 35.3% (N=12) shooting games (first person shooter) and other types of not identified games. Sports games have had 23.5% (N=8) response. Battle/medieval games, history games and real time games received each 17.6% (N=6). Finally, 14.7% (N=5) of the respondents replied platform games.



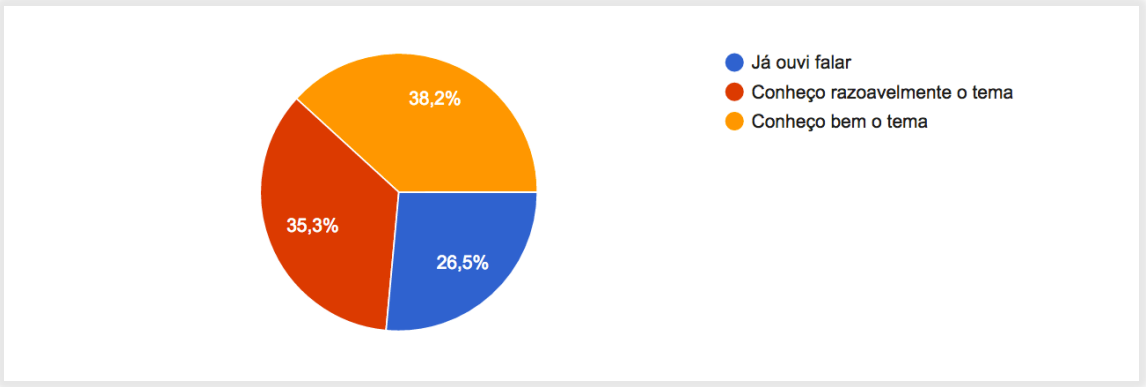

Graphic 5 - What type of games they like to play?

To the question about which device do you usually use to play, 61.8% (N=21) responded mobile phone; 58.8% (N=20) responded the computer; 47.1% (N=16) responded the console; 32.4% (N=11) responded tablet to play.



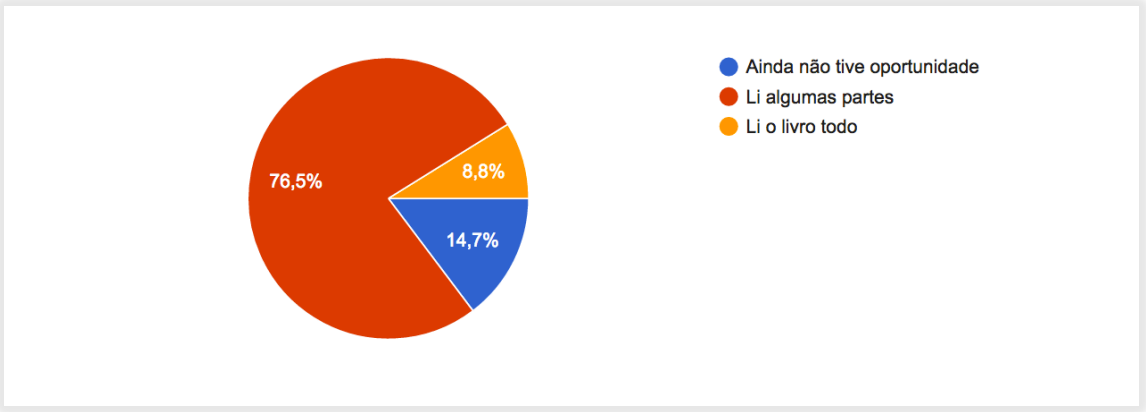

**Graphic 6 - Devices used to play**

In the last phase of the first part of the survey, before starting the actual game, there were two questions on the learning context. The question about whether they knew the theme of disasters: 38.2% (N=13) are well aware of the theme; 35.3% (N=12) know reasonably the theme; and 26.5% (N=9) heardly knew the theme.




Graphic 7 – Do you know the theme?

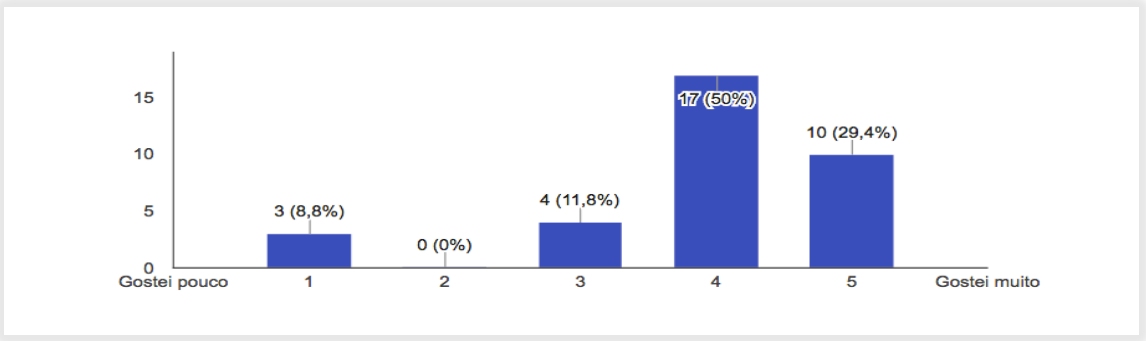
The last question in this segment was related with the book "Catastrophes and Major Disasters" by Isabel Alçada and Ana Maria Magalhães. 76.5% (N=26) responded that they had read some parts of the book; 14.7% (N=5) replied that they hadn't read the book; and 8.8% (N=3) read the complete book.




Graphic 8 – Knowledge about the book “Catástrofes e Grandes Desastres”

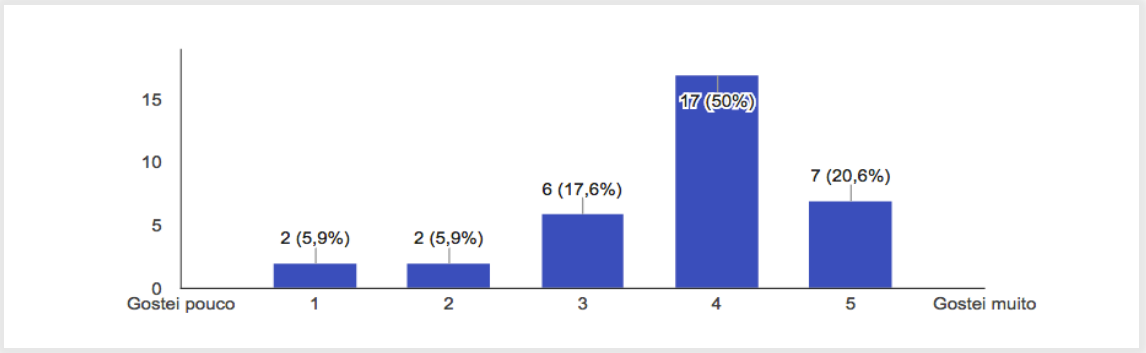
The second part of the survey, also responded individually after the game experience, was a little more extensive than the first part, and aimed to answer a few questions from different contexts: reaction, motivation, user experience and learning.

The questions in the context of the reaction about whether the player had liked to participate in the project, on a scale of 1 to 5, the majority of cases 50% (N=17) + 29.4% (N=10) were very pleased to participate in the project. 11.8% (N=4) were neutral in this analysis. And only 8.8% (N=3) replied they didn't like to participate in the project.



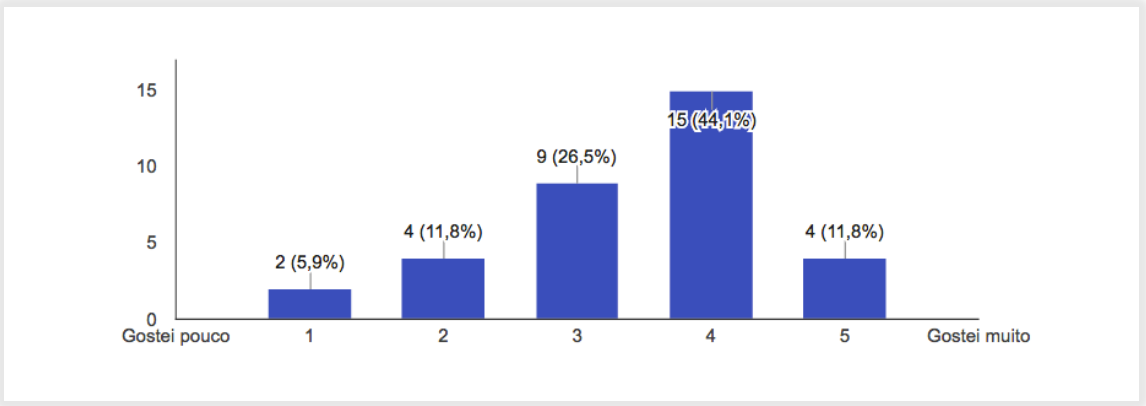

Graphic 9- Project participation

As to the question of whether they liked the format of the game, on a scale of 1 to 5, 50% (N=17) + 20.6% (N=7) demonstrated they really enjoyed the format; 5.9% (N=2) + 5.9% (N=2) reported they did not like the format and 17.6% (N=6) were neutral on the scale between dislike and really liking the format.



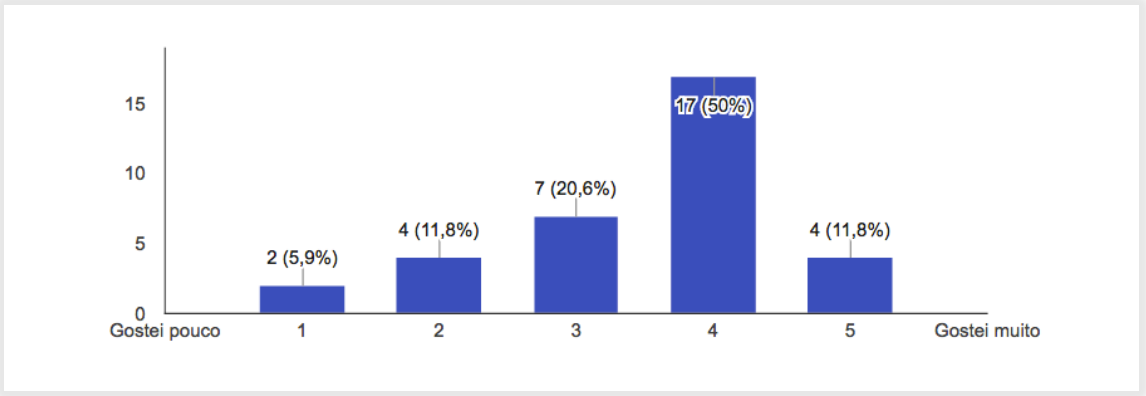

Graphic 10 – Game format

About the visual's of the game 44.1% (N=15) + 11.8% (N=4) responded positively to this question indicating they liked it very much. 26.5% (N=9) responded neutral. And 11.8% (N=4) + 5.9% (N=2) responded that they didn't really like the visual's.



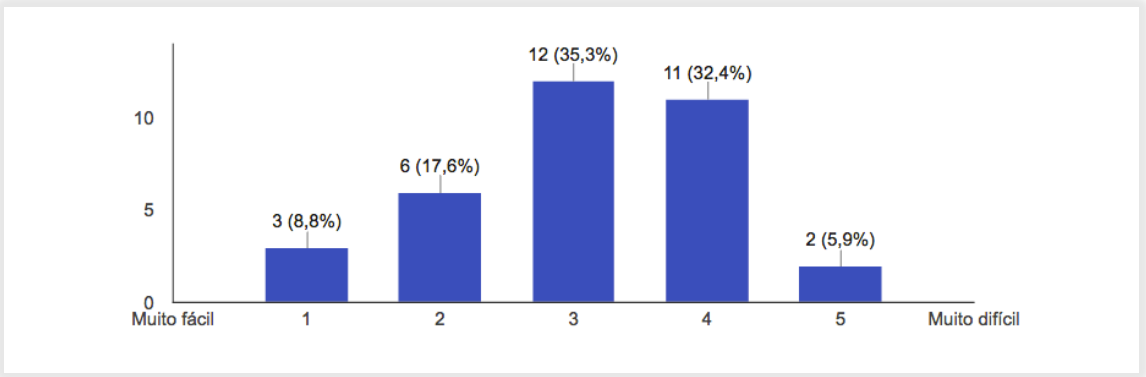

Graphic 11 – Visual aspect of the game

About the overall appreciation of the characters, on a scale of 1 to 5, the majority of cases 50% (N=17) + 11.8% (N=4) were very pleased with the characters. 20.6% (N=7) were neutral in this analysis, neither liked or not. And 11.8% (N=4) + 5.9% (N=2) replied that they didn't like the characters.



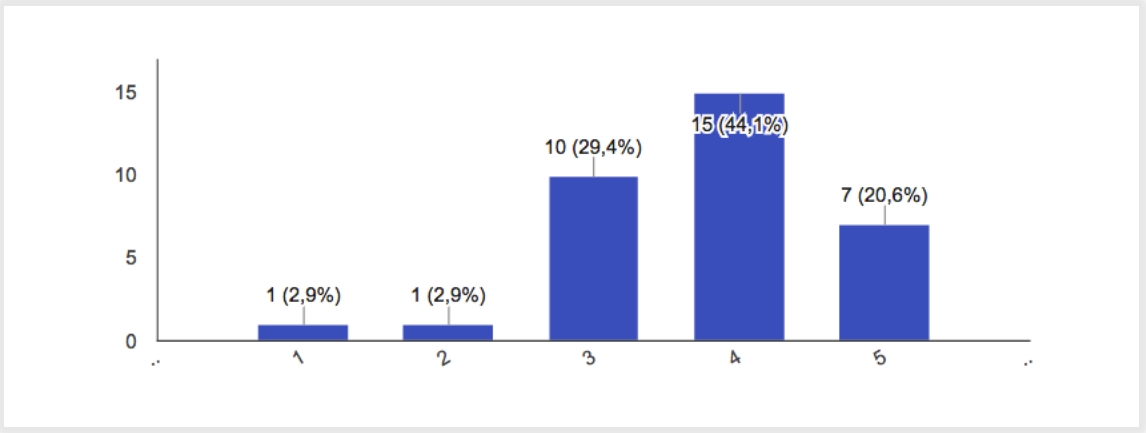

Graphic 12 - Overall appreciation of the characters

In the context of the game difficulty, the sum of 32.4% (N=11) and in 5.9% (N=2) found the game very difficult. For its part, 35.3% (N=12) considered it to be neutral, not very difficult nor too easy. The remaining respondents 17.6% (N=6) and 8.8% (N=3) considered the game to be very easy.



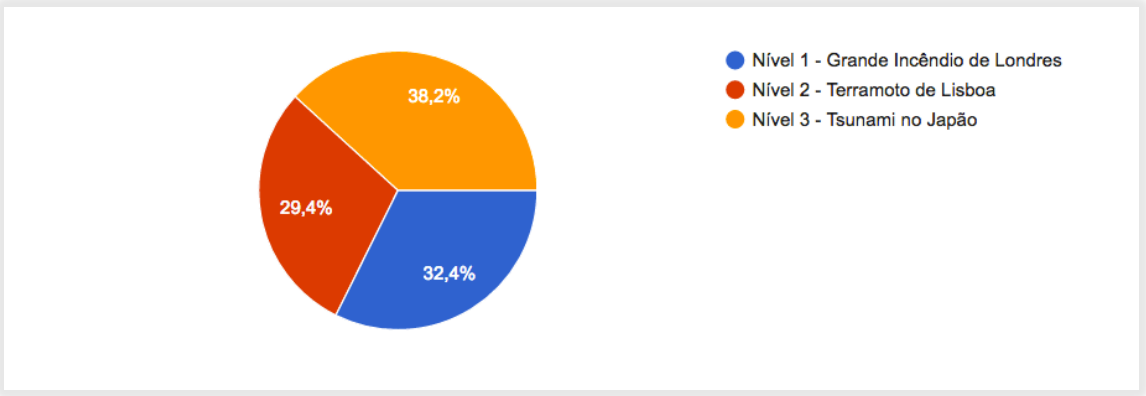

Graphic 13 – Game dificulty

The last question in step 1 - Reaction - analyzes the information throughout the game. The answers obtained, 44.1% (N=15) and 20.6% (N=7) consider the information completely adequate. 29.4% (N=10) of respondents have a neutral response indicating the scale option 3. The remaining percentage 2.9% (N=1) and 2.9% (N=1) considered the information insufficient or inadequate to advance in the game.



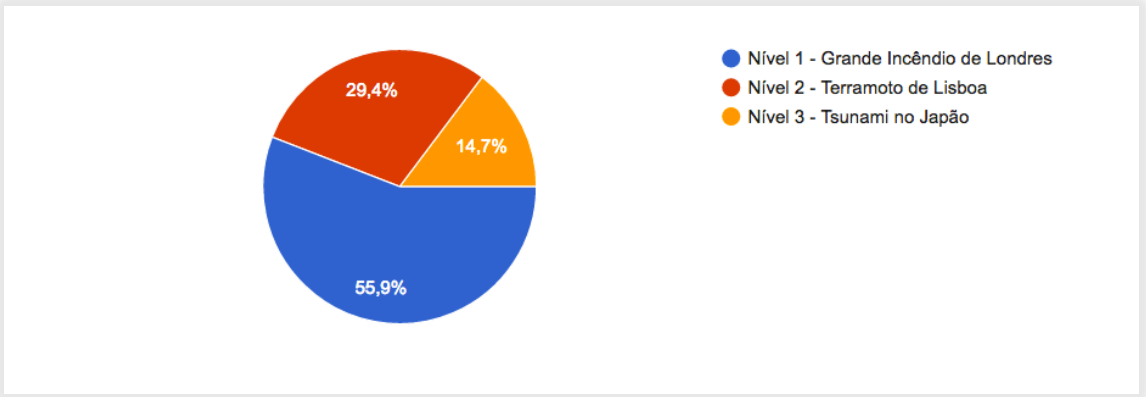

Graphic 14 – Information in the game

On the questions related to motivation, to the questions about what level they most enjoyed to play and what level they liked least, 38.2% (N=13) replied that he/she liked playing the level 3 on the Tsunami in Japan more than the others; 32.4% (N=11) replied the level 1 about the Great Fire of London; and 29.4% (N=10) responded that he/she most enjoyed the theme of the earthquake in Lisbon.



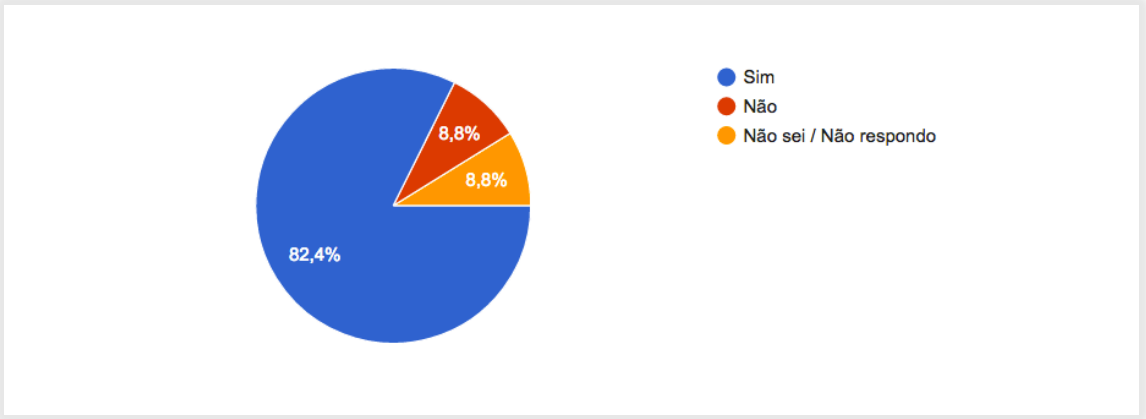

Graphic 15 – Favorite game levels

To the level they enjoyed less question, 55.9% (N=19) responded that they didn't like to play the level on the Great Fire of London; 29.4% (N=10) responded that they didn't like the theme of the earthquake of Lisbon; and 14.7% (N=5) replied that they didn't enjoy playing the level 3 on the Tsunami in Japan.



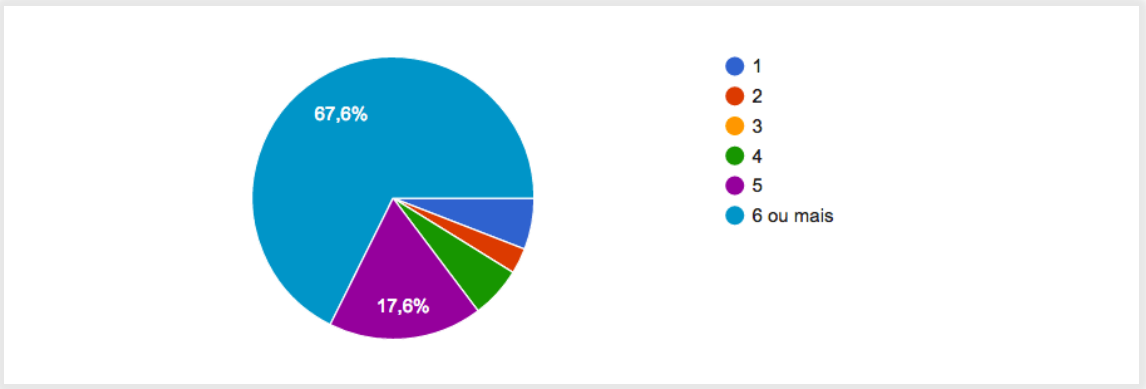

Graphic 16 – Less favorite game levels

About whether they would like to learn more about the topic: 82.4% (N=28) replied yes; 8.8% (N=3) + 8.8% (N=3) replied that they did not know or didn't want to respond.



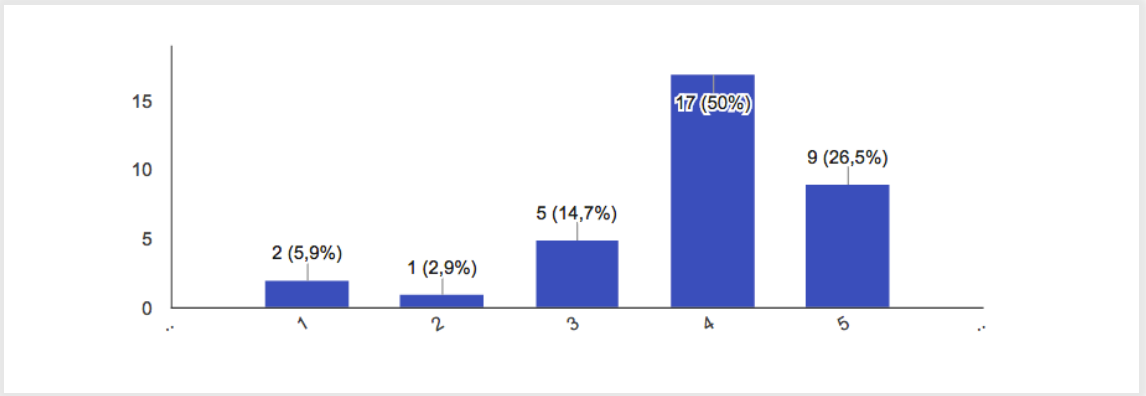

Graphic 17 - They would like to learn more about the topic

To the question on how many levels they would like to have, 67.6% (N=23) responded that they wanted 6 or more levels; 17.6% (N=5) answered 5 levels; 5.9% (N=2) answered 4 levels; 5.9% (N=2) replied only 1 level; and 2.9% (N=1) replied that the game should only have 2 levels.



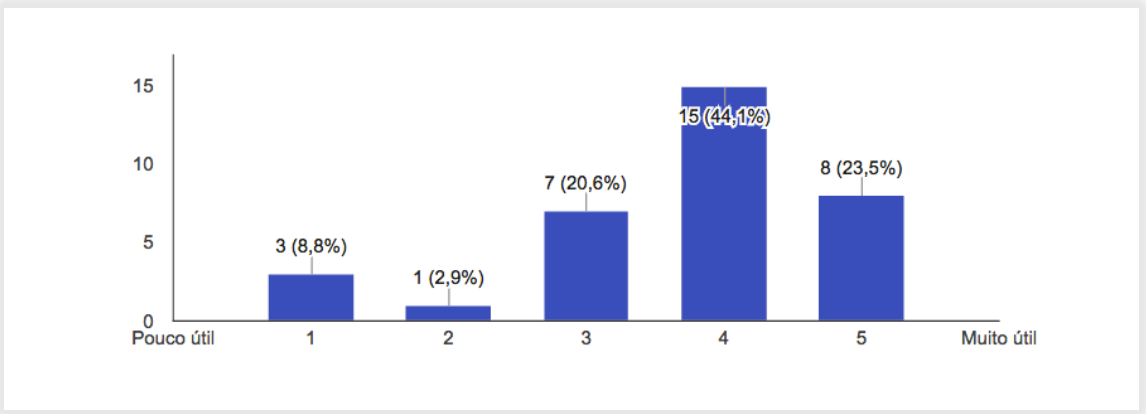

Graphic 18 - How many levels you would like to have?

When asked about the importance of the game content, 50% (N=17) and 26.5% (N=9) considered the content very important; 5.9% (N=2) and 2.9% (N=1) considered the content of little importance; and 14.7% (N=5) adopted a neutral response.



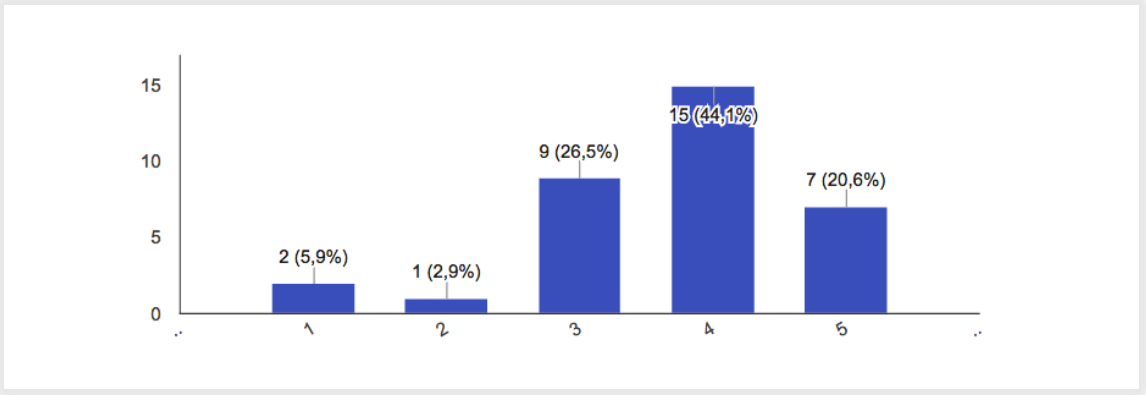

Graphic 19 – Importance of the game content

In the last issue in the segment of motivation, respondents said, on a scale of 1 to 5, if they considered the game a useful tool to learn. 44.1% (N=15) and 23.5% (N=8) considered it a very useful tool; 8.8% (N=3) and 2.9% (N=1) considered a less useful tool; and 20.6% (N=7) adopted a neutral response.



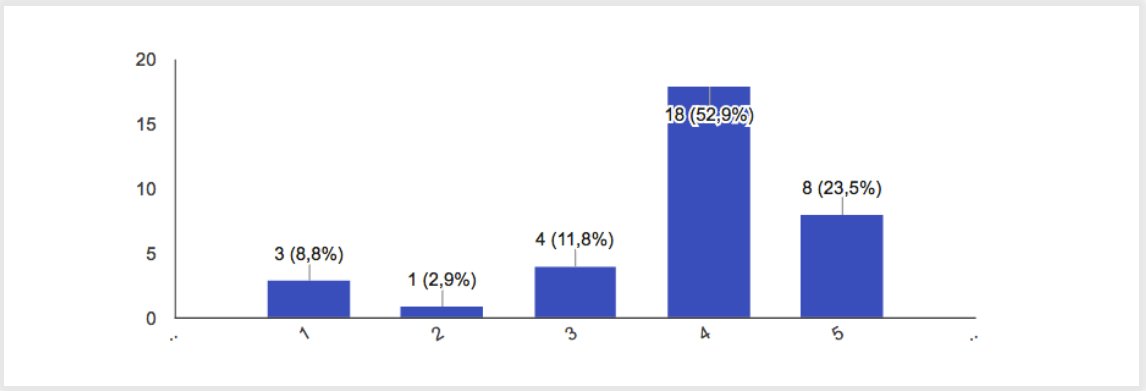

Graphic 20 – Game as a tool

In the context of the user experience, there were asked some questions about the game they had just experienced. On the question on whether they considered the game appealing or not, 44.1% (N=15) and 20.6% (N=7) responded the game was very engaging; 5.9% (N=2) and 2.9% (N=1) responded not very engaging; and 26.5% (N=9) were in the neutral answers of the scale.



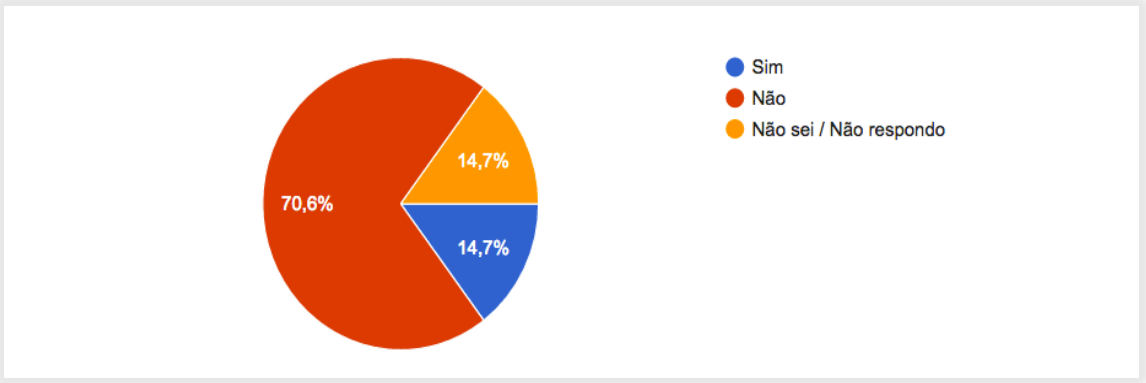

Graphic 21 – Apreciation of the game

To the question about game satisfaction, 52.9% (N=18) and 23.5% (N=8) were very satisfied; 8.8% (N=3) and 2.9% (N=1) little satisfied; and 11.8% (N=4) were more or less satisfied with the game.



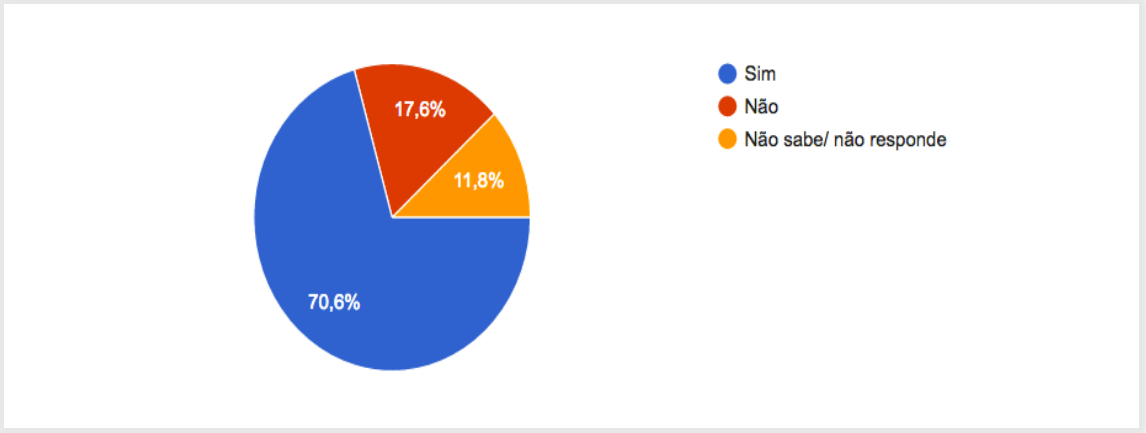

Graphic 22 – Game satisfation

To the question about whether they wanted to quit the game, 70.6% (N=24) replied that they did not; 14.7% (N=5) replied yes; and 14.7% (N=5) did not know or did not respond.



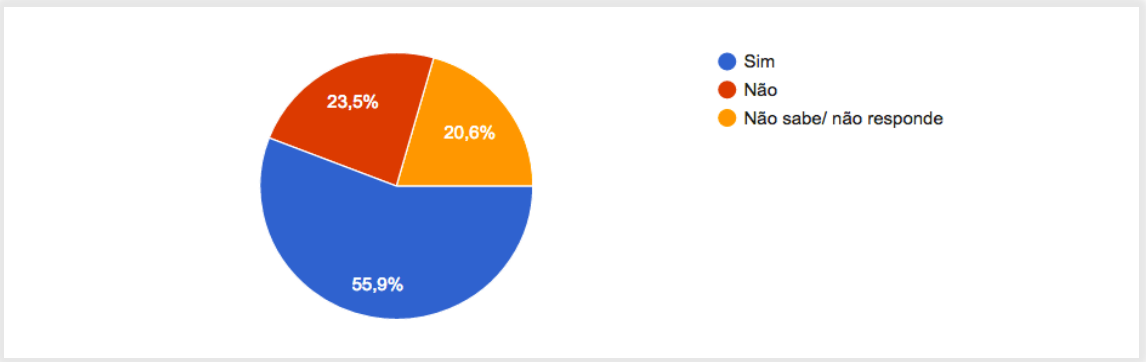

Graphic 23 – Given up

To the question of whether the form of playing was improving throughout the game, 70.6% (N=24) answered yes; 17.6% (N=6) replied no; and 11.8% (N=4) did not know or did not respond.



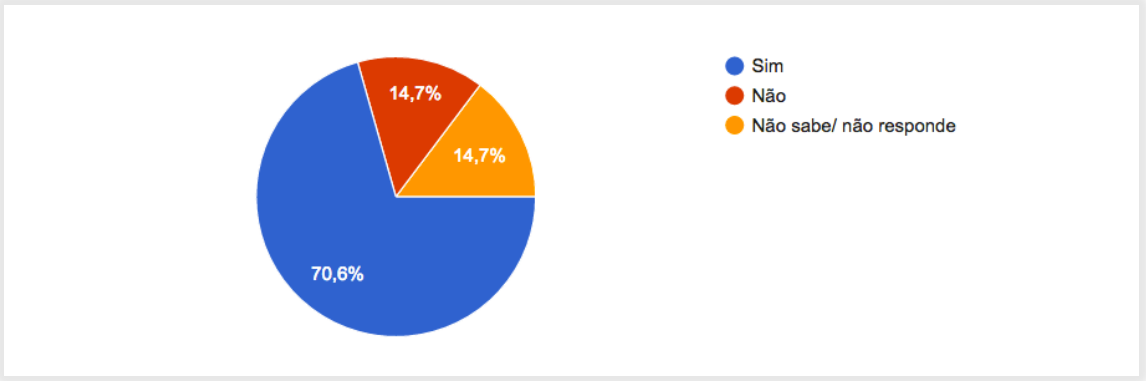

Graphic 24 - The form of play was improving throughout the game

To the question on wether the the game offers new challenges, 55.9% (N=19) responded yes; 23.5% (N=8) replied no; and 20.6% (N=7) replied that they did not know or did not respond.




Graphic 25 – New Challenges

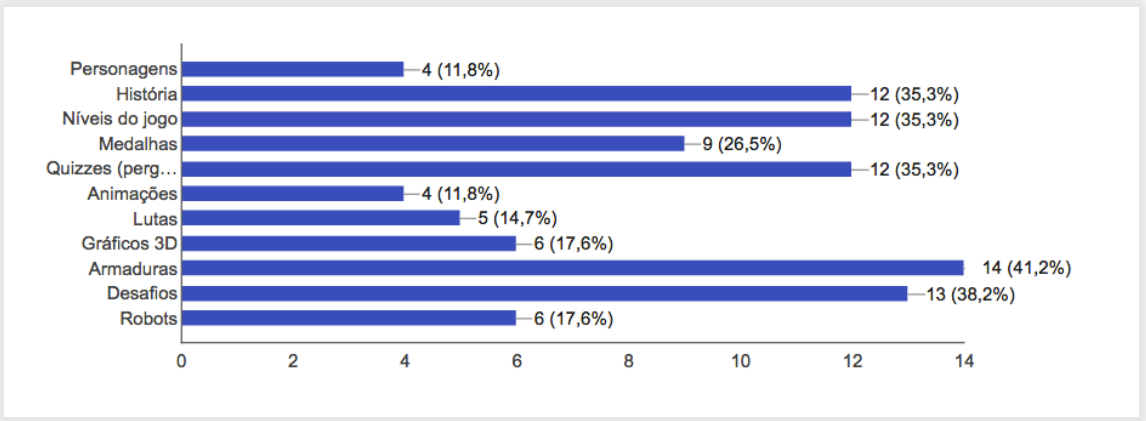
The question about whether they wanted to play again, 70.6% (N=24) answered yes; 14.7% (N=5) replied that they did not want; and 14.7% (N=5) responded do not know or do not respond.




Graphic 26 - Whether they wanted to play again

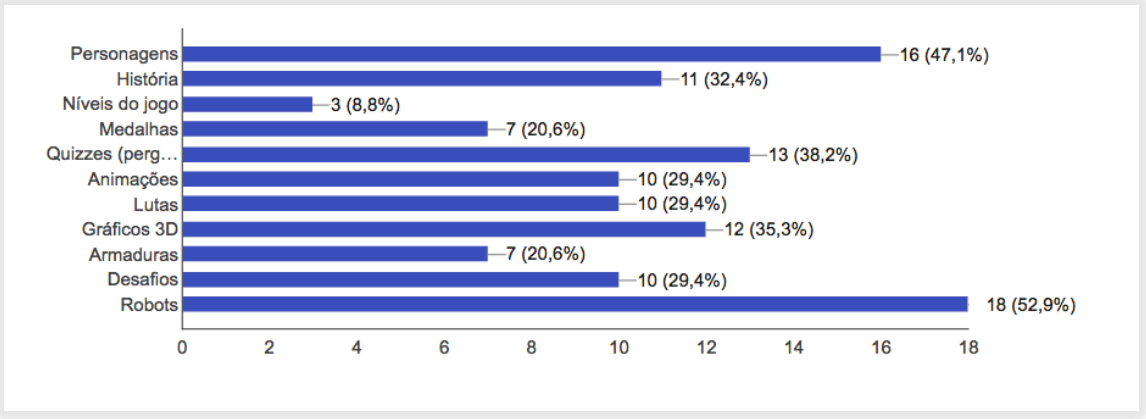
To the last two questions on the user experience, we asked each respondent to indicate the three strong points of the game and the three weaknesses of the game within the categories listed: characters, story, game levels, learning badges, quizzes, animations, struggles, 3D graphics, armours, challenges and robots.

The three strengths identified were: 41.2% (N=14) the armours; 28.2% (N=13) the challenges and as a third strong point ex exequo, with 35.3% (N=12), were the categories of history, game levels and quizzes.




Graphic 27 - Three strengths

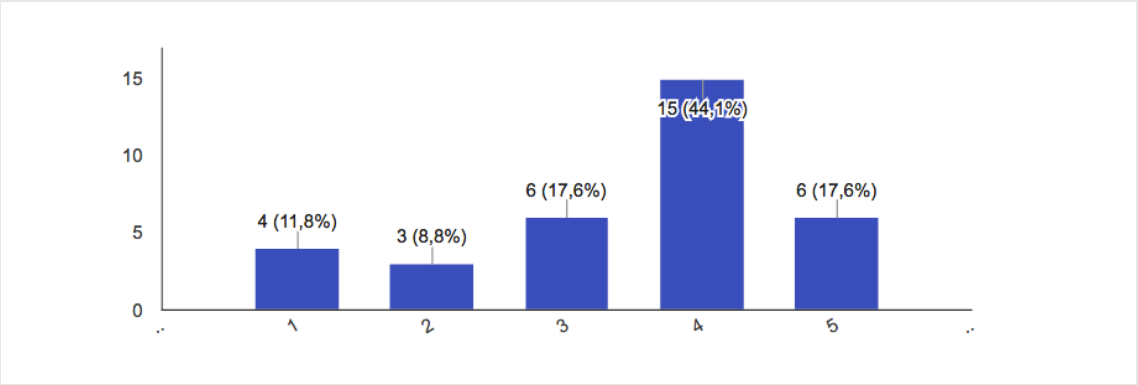
The three weaknesses identified were: 52.9% (N=18) to the robots; 47.1% (N=16) to the characters and, with 38.2% (N=13), the quizzes.




Graphic 28 - Three weaknesses

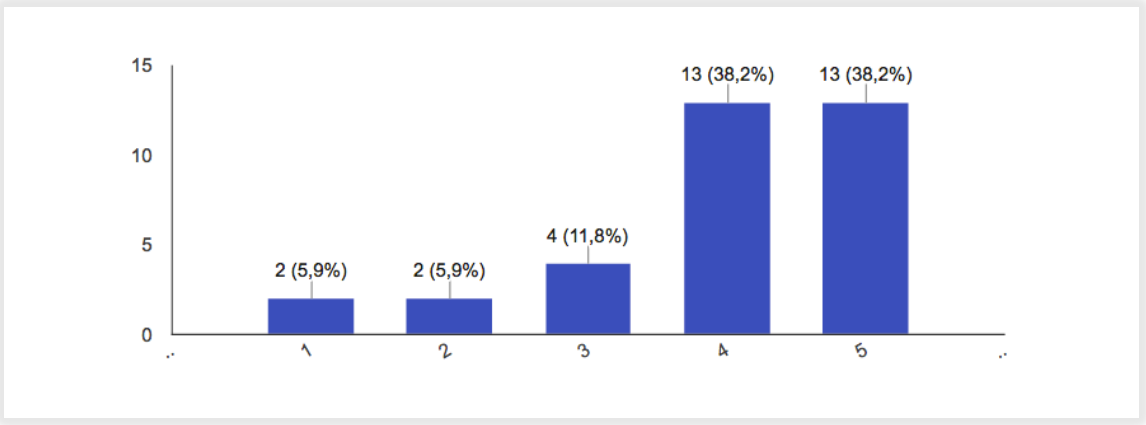
In the context of the learning segment, the questions were raised in the form of affirmation, and on a scale of 1 to 5 each respondent said they were fully in agreement or in disagreement with our statements.

On the statement "The game helped me to better reflect on the theme of disasters", 44.1% (N=15) and 17.6% (N=6) agreed completely with the statement; 11.8% (N=4) and 8.8% (N=3) disagreed; and 17.6% (N=6) did not agree nor disagreed with the statement.



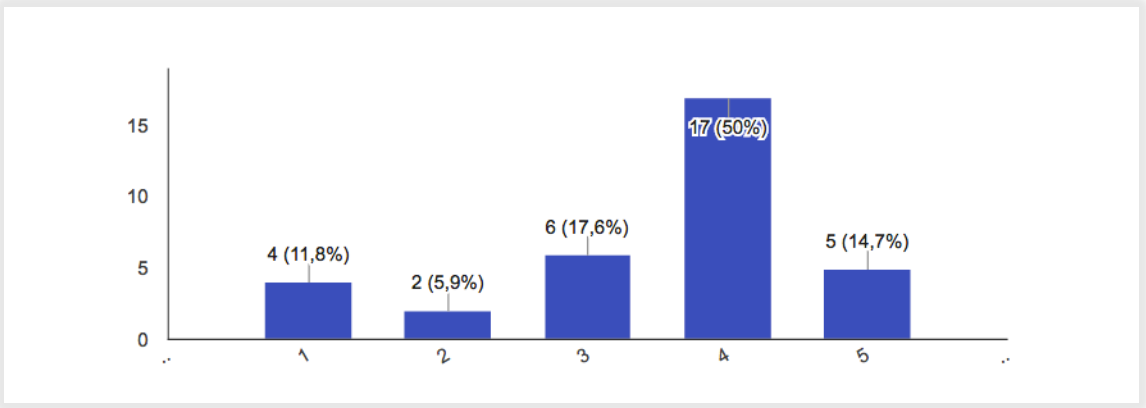

Graphic 29 - The game helped me to better reflect on the theme of disasters

About the statement "it is useful to use games in the classroom", 38.2% (N=13) and 38.2% (N=13) agreed completely with the statement; 5.9% (N=2) and 5.9% (N=2) disagreed; and 11.8% (N=4) did not agree nor disagreed with the statement.



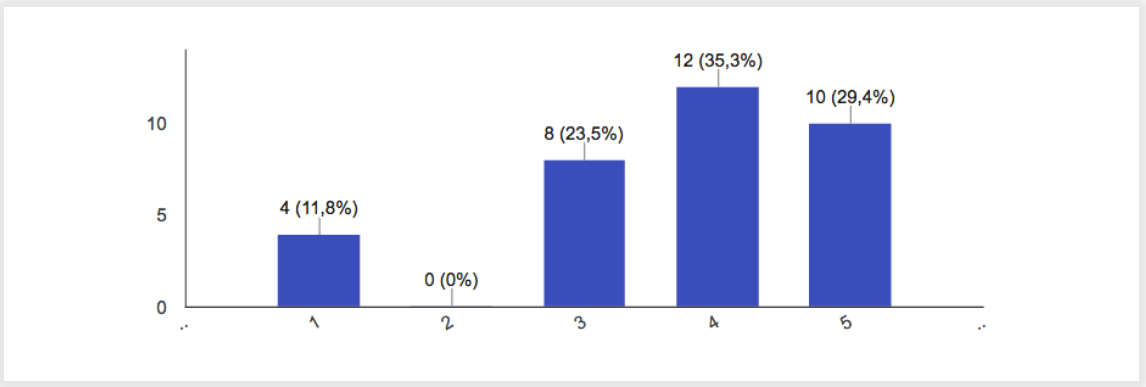

Graphic 30 - It is useful to use games in the classroom

About the statement "The game added more knowledge to what I already had", 50% (N=17) and 14.7% (N=5) agreed completely with the statement; 11.8% (N=4) and 5.9% (N=2) disagreed; and 17.6% (N=6) did not agree nor disagreed with the statement.



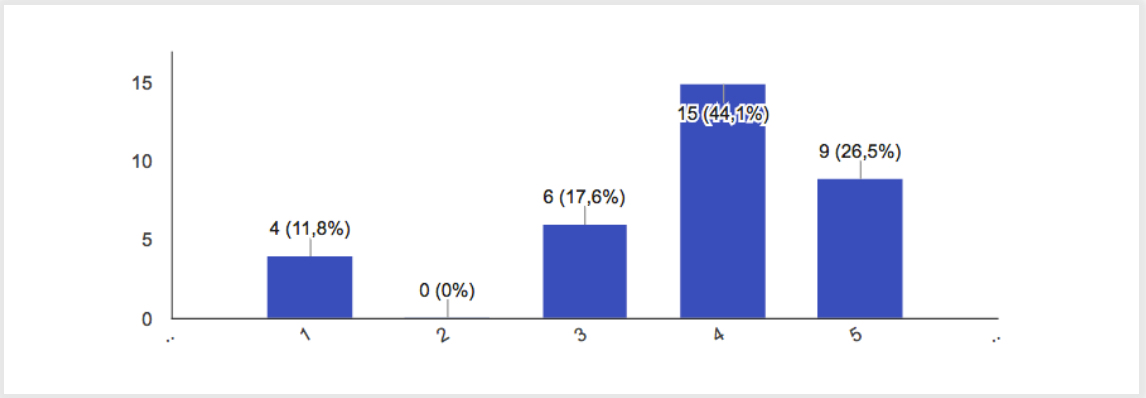

Graphic 31 - The game added more knowledge to what I had

About the statement "The game was easy to understand and follow", 35.3% (N=12) and 29.4% (N=10) agreed completely with the statement; 11.8% (N=4) disagreed; and 23.5% (N=8) did not agree nor disagreed with the statement.



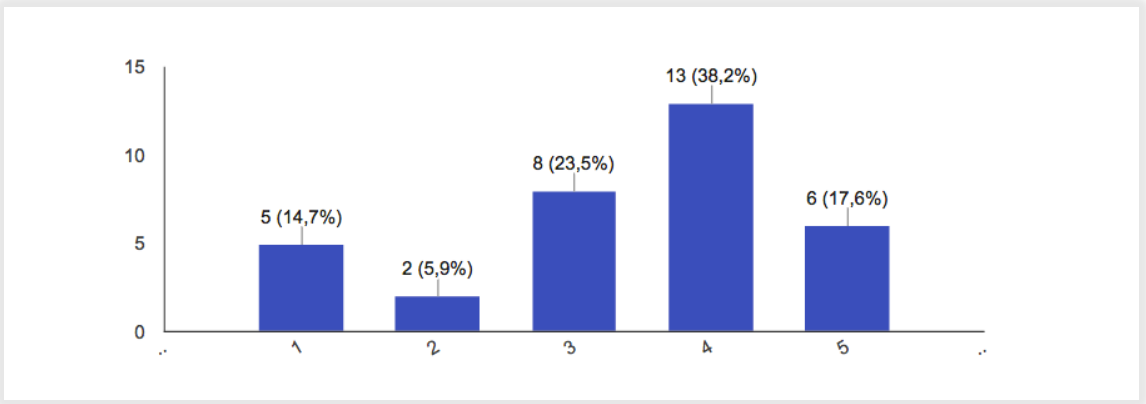

Graphic 32 - The game was easy to understand and follow

About the statement "The quizzes were easy to understand", 44.1% (N=15) and 26.5% (N=9) agreed completely with the statement; 11.8% (N=4) disagreed; and 17.6% (N=6) did not agree nor disagreed with the statement.



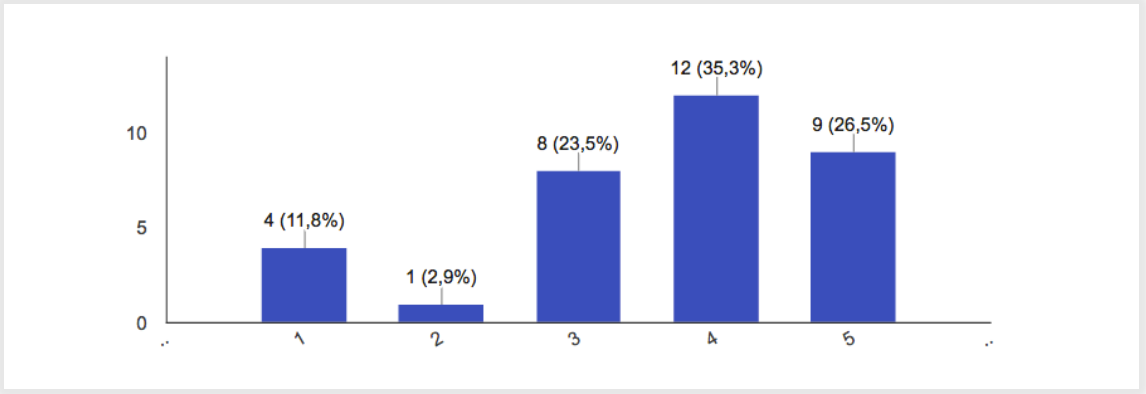

Graphic 33 - The quizzes were easy to understand

About the affirmation "I have learned new content with the game", 38.2% (N=13) and 17.6% (N=6) agreed completely with the statement; 14.7% (N=5) and 5.9% (N=2) disagreed; and 23.5% (N=8) did not agree nor disagreed with the statement.



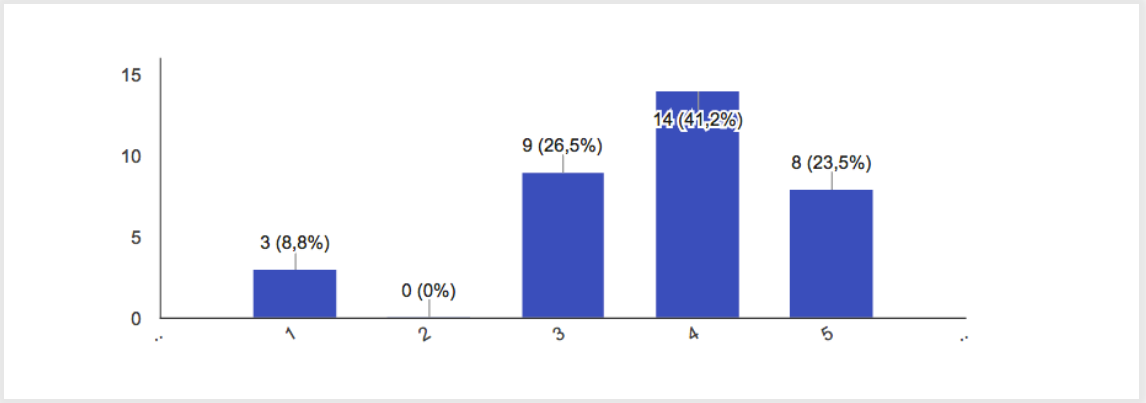

Graphic 34 - I have learned new content with the game

About the affirmation "I can remember the information presented in the game", 35.3% (N=12) and 26.5% (N=9) agreed completely with the statement; 11.8% (N=4) and 2.9% (N=1) disagreed; and 23.5% (N=8) did not agree nor disagreed with the statement.



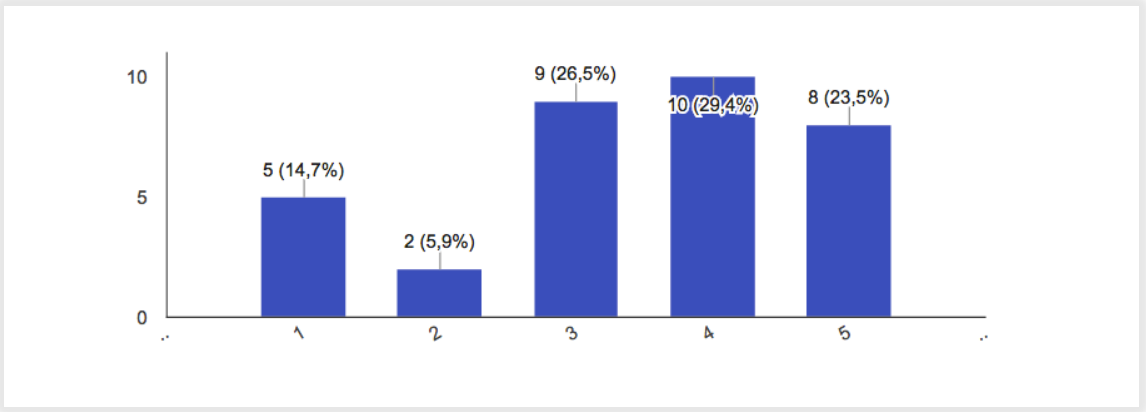

Graphic 35 - I remember the information presented in the game

About the affirmation "I can better understand now the themes presented in the game", 41.2% (N=14) and 23.5% (N=8) agreed completely with the statement; 8.8% (N=3) disagreed; and 26.5% (N=9) did not agree nor disagreed with the statement.




Graphic 36 - I can better understand the themes presented in the game

About the affirmation "I can better put in practice the issues related to the game", 29.4% (N=10) and 23.5% (N=8) agreed completely with the statement; 14.7% (N=5) and 5.9% (N=2) disagreed; and 26.5% (N=9) did not agree nor disagreed with the statement.




Graphic 37 - I fit best the issues related to the game

# 5. DISCUSSION AND CONCLUSION

## 5.1 About the results: opportunities and prospects

The results presented need a deeper relational analysis, thus the analysis that follows reflects on the topics considered most relevant for the controlled experiment.

The first question asked in the survey about the learning expectation the players had from the game, a significant majority (62.8%) answered they thought they would learn something new with the game. And the same number of players at the end of the survey (79.6%) agreed with the statement "I have learned new content with the game". These data indicate that, in this sample, students consider that they have acquired new knowledge with the use of the serious game. It should be noted that other researchers, as Boyle et al (2016) found that the serious games have been used to promote the acquisition of knowledge and refer that “games for learning have been used to promote knowledge acquisition across a wide range of topics and to a lesser degree skill and social skill acquisition and behaviour change.”

When asked about the use of serious games in the classroom context, 79.4% shows that they never and/or rarely use serious games in the classroom context. These data are even more expressive when, at the end of the survey, 88.2% agree with the statement "it is useful to use games in the classroom". With these data we can agree the sample was motivated and interested in using serious games in the classroom context more frequently. This motivation may be related to the emotions on the act of playing, as Connolly et al (2012) refer “playing games is increasingly linked to learning and several models have been developed that identify distinct learning outcomes that playing digital games can have. Garris, Ahlers & Driskell (2002) made a basic distinction between skills based learning outcomes (including technical and motor skills), cognitive outcomes (including declarative, procedural and strategic knowledge) and affective outcomes (beliefs or attitudes). This latter category reflects the potential of games to change players’ emotions in addition to helping them learn.”

On the question about whether they knew the theme of disasters, the students (61.8%) reported that they knew fairly well the theme or had heard of it before. However, it is highlighted at the end of the survey that 70.3% reported the game has helped them to reflect on the theme of disasters. Thus, we can detect an increase in the interest on the theme of disasters. On the other hand, and still on the subject of disasters, a substantial majority - 91.2% - reported that after the game he/she gained a better understanding on the theme; and 79.4% reveal that they can better apply the acquired knowledge about the disasters after playing the game. It is important to highlight that the veracity of applying the acquired knowledge must be assessed later by the teacher. In other words, if after this controlled experiment, the responsible teacher runs a knowledge, he can check if it the students can apply the knowledge acquired throughout the game. As regards Filonenko (2015) "For serious games to be considered a viable educational tool, they must provide some means of testing and progress-tracking and the testing must be recognizable within the context of the education or training they are attempting to impart. Various methods and techniques have been used to assess effectiveness of serious games, and various comprehensive reviews have been conducted to examine the overall validity of game-based learning."

Other relevant data, which relates to the theme of disasters, is the fact that 82.4% respondents indicated they would like to learn more about the topic, i.e., they consider that the process of acquisition of knowledge would be more complete if the serious game had more information available throughout the game. With this, one can infer that the use of serious games should be used as a strategy in the classroom context. Although, this is not a single solution, but according to these results, it can be part of the solution that encompasses different characteristics. Yusoff et al (2009) mention that "Serious games need more time and effort to be spent on them than a text book or video, it has to convey the educational message whilst still being enjoyable for the user to play and want to replay again. Another factor is that game developers have different experience than educators, due to the fact that digital game designers and educational experts do not usually share a common vocabulary (Yusoff, Crowder, Gilbert, & Wills, 2009)."

We should also emphasize that 88.2 % of respondents considered the game to be a good way to learn. It should be noted that there wasn't determined wether the students regard this as a better way of learning inside or outside the classroom. However, they data are relevant, as they demonstrate the interest in this type of strategies in the context of digital learning. The answers reveal that 70.6% would like to play again. In other words, even if it is the same game, with the same thematic, they would still enjoy to play again. The researchers Lunn et al (2016) reflect that "rather than an "all comprehensive" teaching tool, serious games look particularly suited as an instrument for motivating beginners to new topics and as a practicing tool to apply and test knowledge acquisition (Ott et al., 2011). This again shows that current serious games do not have the capability to replace a teacher in the classroom and they are additional tools, which introduce children to a new topic or to test them on current topics they have been studying."

Along the controlled experiment, some students raised questions about the development of the game, particularly how long did it take to build, who thought in the 3D and who developed the story. In other words, they were interested in knowing about the development and the process until achieving a final product. It should be noted that 67.6% indicated they played almost every day of the week and only 5.6% responded that they hadn't the habit of playing. Thus, the use of games is recurring on their day-to-day. Lunn et al (2016) reflect on the use of games by children "children are getting used to learning with computer technology earlier in their life, compared to 10 years age (Shields & Behrman, 2000). Targeting serious games at a younger age would be more suitable. Children are growing up with technology developing around them, so getting them involved with it at an early age will help them later in life."

On the other hand, it is interesting to analyze that in the preferences for the use of the devices to play, the mobile phone (61.8%) and the computer (58.8%) lead the preferences. The serious game presented, Alpha Patrol, has an online version (for the web) and also an offline version, plus different versions are available in the applications stores: Apple and Android. Regarding theses results, we consider the option to create the game in multiplatform was

successful, since it corresponds to the needs and requirements of the target audience of serious games. In a study of the Games and Learning Council was also observed the preference in access using mobile devices

> "The state of technology and the way games are used by teachers appears to be evolving quickly. Use of tablets, while still not the primary tool for playing games in the classroom, continues to grow. The GLPC survey found that a majority of teachers still use desktop computers to play games (72%) and a sizable group (41%) is using interactive whiteboards. But still, tablets have quickly grown to equal the whiteboard usage. This growth of mobile technology was also highlighted in a new survey from the technology and education firm Amplify. That survey found that of those not using tablets 67 percent plan to invest in them in the next 1-2 years."

Still on the analysis of the results of the controlled experiment, it seems important to reflect on the difficulty of the game. In the first phase of the survey when asked about what they thought would be the degree of difficulty in the game, and taking into account the previous user experience of each one, 79.4% indicated that the game would be too easy. However, in the second part of the survey, and after having experienced the game, 73.6% considered it a difficult game. We believe that this change of opinion, between what they thought previous and the reality after the experience, is due to the fact that the majority of educational materials and tools used in the classroom context do not constitute a challenge for the students. In fact, even when considering the difficulty of the game, the students would like the game to have even more levels and 94.1% of the students reported they considered the game information enough to move to different levels. It is therefore considered that the difficulty of the game is something that pleases the players, being a challenge. Saphiro, about the study Games and Learning Council, adds "It is clear that digital games are becoming commonplace in the classroom. Teachers understand that games provide another instructional tool that's not only engaging, but also simulates contextualized, or hands on, learning experience."

To conclude, it is important to reference the project as a whole. From the data collected, 91.2% of respondents liked to participate in this project; 88.2% liked enough the format of the game; 82.4% enjoyed the visual aspect of the game; and 88.2% showed to be satisfied with the game from the point of view of the user experience. These data reveal a high degree of satisfaction and exceeded the expectations of the research team.

C.I.T.I has always carefully respected the interface between research and development, but we consider, in the case of this research project, the lack of time as the main obstacle, since ideally the project should have several phases of experience, analysis, and surveys.

The development of serious games requires time and a multidisciplinary team. Van Eck (2006) reflected on this question, "touted by many as the "Holy Grail" approach to DGBL because of its ability to potentially address educational and entertainment equally, and to do so with virtually any domain, this professionally designed DGBL process is more resourceintensive than the first option. This is because the games must be comparable in quality and functionality to commercial off-the-shelf (COTS) games, which after all are very effective in teaching the content, skills, and problem-solving needed to win the game".

In the end, the result of the controlled experiment was positive and allowed to reflect on the work done. The characteristics of the school allowed for an organized and controlled experience, revealing to be a good embryo for the development and integration of serious games in the educational context.

Thus, when we reflect on the learning objectives proposed for the serious game, we believe they were achieved, to the extent that users revealed that:

a) They learned from the experience of the serious game;

b) Reflected on the theme and on the use of serious games in the classroom, and revealed that they would like to use this strategy more often.

c) Considered the quizzes as one of the strong points of the game, given that they received feedback on the level of their knowledge.

Another aspect that deserves consideration is the integration of the learning badges. In fact, in the conceptualization of the project, when integrating the learning badges as motivating agents, the research team thought they would be more appreciated. However, it was found that students considered it a minor aspect in the learning acquisition: despite the initial interest, the players did not consider the badges interesting enough for collecting. They were more interested in getting ahead in the narrative of the game.

This aspect forces us to reflect on the reasons that may cause badges not to be considered as elements of motivation of a serious game. In the specific case of the controlled experiment, both the lack of visibility of the learning badges in the serious game, or indifference by the possible advantages of badges may have contributed to the low compliance. The age range can be one of the reasons for the lack of interest in the acquisition and demonstration of badges. Davis & Klein (2015), about a study with secondary school pupils, reported that "the youth participants in the current investigation were not interested in using badges to connect their science center experiences with their school lives, and they did not want to share these experiences with their friends or family members. They did value the ability to use their badges in the college admissions process, but they raised concerns that such external audiences may find it difficult to assess the worth of a particular badge without some level of standardization in the badge awarding process."

However, we cannot fail to mention that there is still a way to go when it comes to analysis of the learning badges as an agent of motivation. Davis & Klein (2015) mention "considerable interpretative work is required to make sense of badge collections, raising challenges related to validating the credibility of badges earned in diverse contexts."

## 5.2 Final Considerations

The use of serious games in the learning context in Portugal is not a common practice in educational context. There are many authors who claim that the use of digital technologies in schools is still insufficient and most models of education are still based on readings on the books and exercises without the use of additional material textbook.

In this sense, this dissertation was developed both for the definition of strategies for the use of serious games and e-Learning, proposing a pedagogical use of serious games in the classroom in order to motivate and consolidate the acquired knowledge. A controlled experiment allowed us to define the parameters of the serious game created, the motivation elements, and the relevance of using different strategies, like the book, the quizzes and the learning badges.

The objective was to analyze one of the strategies that may be susceptible of generating motivation in the context of digital learning. In order to achieve this goal, an analysis of trends and characteristics in digital learning was made. After this analysis, the serious game that was used in the controlled experiment was developed. The results indicate that the game really should not be regarded as a tool in the learning process, but rather a complement in order to act as a facilitator in the process.

The serious games can also be an object of evaluation, in addition to other methods, however, this aspect has not become clear in this dissertation as to assess the potential for evaluation, one would need more time for research.

We believe that the creation of serious games depending on the needs presented can be a way to improve the digital learning strategies. This concern begins to have space in political *agendas*; the Ministry of Education of Portugal revealed, "the use of digital games in the promotion of learning, although it is not widespread, is already used in many Portuguese schools". One example of this integration is the Programming Initiative in the 1st cycle of Basic

Education, from the General Directorate of Education (GIP), which covers "more than 700 teachers and 27 000 students of 3 and 4 years of schooling and obeying the logic of game (the Scratch and the Kodu, for example)" (Jornal Expresso, 2016)[44].

In this context, we identify some lessons learned during the development of the games:

1. Do not underestimate the time and costs that are necessary to develop a serious game;
2. The interdisciplinary teams are vital in the process;
3. Each element of the team has their specialty;
4. Achieving a concept that pleases the whole team is slow process;
5. The integration of elements to promote learning may not be obvious;
6. The planning and identification of objectives and competences should be made at starting point.

Duncan, Fabola and Miller (2016) stated “a mix of learning styles is recommended by many educationalists, from reading texts to performing practical laboratory or classroom exercises, coupled with videos or discussion classes. (...) Technologies are advancing faster than tutors can embed them into educational scenarios or environments. However, this technological race gives educationalists a rich variety of tools to use and create experiences that students will enjoy, remember and learn from.” (Duncan et al, 2016)

In this sense, Duncan et al (2016) proposes some goals for 2025 in order to develop strategies and/or tools for digital learning. To highlight:

a) the development of games must have a close relationship with the theories of learning, enabling scaffolding mechanisms for the student;

44 Translation from the original reference “a utilização de jogos digitais na promoção das aprendizagens, apesar de não estar generalizada, já é utilizada em muitas escolas portuguesas". Um dos exemplos desta integração é a Iniciativa Programação no 1º ciclo do Ensino Básico, da Direção-Geral da Educação (DGE), que abrange “mais de 700 professores e de 27 000 alunos dos 3.º e 4.º anos de escolaridade e obedecendo também a uma lógica de jogo (o Scratch e o Kodu, por exemplo)"

b) the narrative is as important as the remaining elements of the game;

c) goals must be different to respond to the individual needs of each student;

d) the student assessment should be more demanding, not only quizzes or multiple choice tests;

(e) the support of the mentor/tutor should be structured to allow the students to learn at their own pace, but with recognizable goals to achieve the objectives and competences.

It is therefore considered that there is a vast area to explore, but seems to be through small experienceslike this thesis that the integration of serious games can involve in the routine of digital learning. The researcher Jose Zagal considers it is important to know how to establish conections between games and learning “having a deep understanding of games is more than being able to analyze games in a meaningful way, know how, and why, games help create certain experiences and evoke certain emotions and feelings in its players. It is also more than knowing how games are used, and can be used, as an expressive medium, or being able to engage in informed discussions on the merits (or lack thereof) of a particular game. Understanding games is about having the ability to establish connections between games and between games and anything else. Supporting learning about games is thus about facilitating these connections.”

This conection has been object of discussion since the time of Plato, who said “you can discover more about a person in an hour of play than in a year of conversation”. In fact the transmission of emotions, ways of being, thinking and even learning, may be susceptible of analysis through the act of play. It is the researchers role to develop and deepen this study and levels of conections. We believe serious games can serve as a means of, not only develop the knowledge on a specific domain and the student capabilities, but also the identity and values

that are keys to the personal growth, and in some cases, professional. The data collected during a game may allow an understanding of how students discuss and resolve problems, and thus be able to have a notion of the trajectory that are developing along their learning route.

This learning trajectory or progression seems to be an essential point in the development of serious games “Learning progressions sometimes called learning trajectories, describe how learners move from less sophisticated to more sophisticated understandings of a given topic. If we think of standards or learning outcomes as the goal, learning progressions describe how students get there. Of course, most domains offer multiple paths to get to outcomes, and most learning progressions attempt to identify those and/or identify paths associated with a particular curriculum.” (DiCerbo, 2015)

The author adds that these data, taken from the game, may be useful in the evaluation “these invisible assessments in games assess things we might not otherwise be able to. Identity and values, if assessed at all, are generally measured by self-report. Gathering information about student interactions "invisibly" in a digital environment allows us to make observations in different, authentic contexts, providing a broader range of evidence on which to base our inferences.” (idem)

### 5.3 Contributions of the study

Research in the area of education is the result of the convergence of different knowledge areas. There are several methods that can be adopted in order to obtain different types of response to initial problems of research. When developing a research in this area it is necessary to have a holistic view of the problem. In this research, in particular, we sought to answer the initial question of research on the different uses of strategies for serious games and e-Learning.

It should be noted that the creation of a digital object for a case study is not a common practice within the doctoral program of Digital Media, as to conceptualize and develop a project like this requires access to a multidisciplinary team. This was not a problem in this process; however, issues such as time and duration of the tests were frequently mentioned as a limitation. For example, the lack of time meant that the tests phase was done only with a reduced sample. This sample limitation could be surpassed with the possibility of using a school with less favorable conditions to the adoption of educational strategies, as is the case of serious games, constituting a higher value in the process. Possibly, if we could use the serious game in different schools, with students with different background, it could be an opportunity to share experiences, opinions and expectations. It is furthermore believed that with feedback from the students some characteristics of the game could be changed in order to meet the expectations of the participants.

The use of the game and the book, in a more general nature, with different sizes, in different cultural circles would be an interesting aspect of analysis as well.

It is hoped that for future investigations, the use of learning badges is deepened in order to identify elements of motivation in the use of serious games. The use of learning badges depending on the target audience is to be emphasized. It became clear, however, that the type of usage that may be developed, is directly related to the audience. As regards, Easley and Ghosh (2016) state that “It is important to note here that different users may value these badges differently; in fact, it is conceivable that there are subpopulations of users who value absolute accomplishment more highly than relative accomplishment, and vice versa. If this is indeed the case, the nature of the user population attracted to the site may vary endogenously depending on the nature of the reward offered by the site.”

Thus, understanding the relationship between the users and the badges is critical in future studies “developing such a nuanced understanding of how users value the social-psychological rewards created by badges is essential to designing effective reward mechanisms for incentivizing user contribution and participation on the Web.” (Easley e Ghosh, 2016)

It should be noted that the creation of serious games is expensive: various experts in the multimedia field are needed to advance in this kind of project. Simon Egenfeldt-Nielsen (2010) notes “If we compare serious games with existing average industry prices for e-learning the difference is not significant. Generally speaking 1 hour of e-Learning with multimédia will cost $65.000, whereas a more traditional e-learning application will cost $35.000”.

A final point of analysis is the evaluation of a serious game: how can the integration of the evaluation of a serious game be made in order to constitute a tool in the student learning process? In fact, the development of further analysis on the use of the serious game would be an asset. Belloti et al (2013) states, “Assessing the user learning within a simulation or serious game is not a trivial matter, and further work and studies are required. (...) In general, for assessment design, it must be stressed that clear goals must be set, followed by techniques to collect data that will be used to verify these goals. (...) Better integration of assessment in games is essentially a matter of definition of the proper mechanisms and conditions to activate them. It is important that these mechanisms should be general and modular, so to be seamlessly applicable in different games. This will increase efficiency in designing games and authoring contents, which is a key requirement for the serious game industry.”

It is therefore believed that for future investigations the question of evaluation is an essential point of analysis and testing. In a final analysis, we believe that with this research one can develop a more refined research to be able to build strategies for the design and theory of serious games and its integration into digital learning. As such, researchers and game designers can create better games, and possibly better methods of evaluation.

On the other hand, another possible path for future research is the use of narrative, as identified in this thesis, and as authors as Deterding et al (2011) and Prestopnik & Tang (2015) reflect as being essential. The researcher Äyrämö (2011) mentions “the authors using game scenario based approach state that as experience is considered as a system, in a game it is possible to design structured, predefined experiences unfolding in time. In the context of the structuralism-inflected approach, narrative contextualizes the player activities and enhances

emotional engagement in playing. Furthermore, it is said that through role playing, the players can experience feelings, empathize other player's feelings and by that way update their understanding of the situation at hand."

However, much remains to be analyzed in the context of serious games, because this is a field with plenty to explore. For example, in the national open acess scientific repository the keyword "jogos sérios" is the object of 8 dissertations of doctoral studies. Using the expression in English, as it is more commonly known, "serious games", there are 26 dissertations of doctoral studies, which have this theme as their object.

In 2003, James Paul Gee alerts to the need to talk about games:"I want to talk about video games - yes, even violent video games - and say some positive things about them" [45], with the goal of addressing why the success of this type of games. However, 13 years of research past, and we still consider this as a field with areas to explore, and, using the words of Lameras et al (2016)

> "Current literature on the field of SGs is inconclusive as regards the provision of a comprehensive analytical structure on SGs design, due to several complications. First, drawing on both game and learning attributes essential for creating an engaging, immersive and transferable learning experience to the student. Second, serious game development has a broad remit, covering the large-budget; repurposable, digital solutions aimed at wide markets, the role of the teacher in guiding learning via games seemed to be fuzzy and unclear and may lead to confusion during the design stage, and finally, a lack of comparative evidence, with games often assessed only in terms of their individual successes or failures, makes it difficult to ascertain whether success or failure was due to a specific design choice or omission."

In 2012, Anant Agarwhal, president of EdX, on the symposium for the future of

45 Statement of J. P. Gee (2003) in his book *What Video Games Have to Teach Us About Learning and Literacy.*

education [46], regards "If great lecture is theatre, the future of learning is games." In this sense, it will be that we are witnessing a paradigm shift in the way we learn? A paradigm shift in the way we teach?

46 2012 MIT Alumni Leadership Conference retrieved from http://storify.com/mitalc/2012-mit-alumni-leadership-conference.

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## APPENDIXES

"Catástrofes e Grandes Desastres" book of Isabel Alçada and Ana Maria Magalhães (available for free online http://portugalseguro.apseguradores.pt/index.php)

Serious games created under this thesis. Available for download at

http://portugalseguro.apseguradores.pt/jogos.php

Digital Survey – Part I (before game play). Available at http://goo.gl/forms/NE3hi8RB9yL0Kbdm2

# PARTE I - Reação

Experiência controlada, no âmbito do doutoramento em Media Digitais (UNL/UT AUSTIN), a decorrer em três fases distintas:

1. Questionário inicial, em formato digital, a ser respondido individualmente. O objectivo é conhecer os níveis quer de jogabilidade, quer de conhecimentos prévios sobre a matéria e a utilização de jogos em contexto de sala de aula;

2. O jogo. Os alunos experimentam o jogo e tentam avançar nos diferentes níveis;

3. Questionário final, em formato digital, a ser respondido individualmente. Estas questões servem para analisar o que aprenderam, o que acharam de forma geral do jogo e a relação que conseguiram estabelecer com o livro das professoras Isabel Alçada e Ana Maria Magalhães.

*Obrigatório

## Achas que vais aprender algo novo com o jogo? *

- ◯ Sim
- ◯ Não
- ◯ Não sei / não responde

## Parte I - Motivação

Numa escala de 1a 5, achas que o jogo vai ser fácil ou difícil? (escolhe uma opção entre 1 e 5 em que 1 significa que achas muito fácil e 5 muito difícil) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| muito fácil | ○ | ○ | ○ | ○ | ○ | muito difícil |

Os teus professores costumam usar este tipo de jogos na sala de aula? *

- ○ Nunca
- ○ Raramente
- ○ Algumas aulas
- ○ Muito frequentemente
- ○ Todas as aulas

## Parte I - Experiência do utilizador

Costumas jogar com que frequência? *

- ◯ Nunca
- ◯ Uma vez por mês
- ◯ Uma vez por semana
- ◯ Só ao fim de semana
- ◯ 3 vezes por semana
- ◯ Todos os dias

Que tipo de jogos gostas mais? (escolher 3 opções) *

- [ ] jogos de plataformas
- [ ] jogos de ação e aventura
- [ ] jogos de desporto
- [ ] jogos de estratégia
- [ ] jogos de batalha /medievais
- [ ] jogos com história
- [ ] jogos de tiros (First person shooter)
- [ ] jogos com vários jogadores em simultâneo (multiplayer)
- [ ] jogos em tempo real
- [ ] outros

Costumas jogar ... (indica todas as opções que se apliquem ao teu caso) *

- [ ] no computador
- [ ] na consola
- [ ] no telemóvel
- [ ] no tablet

## Parte I - Aprendizagem

Conhecias o tema das catástrofes? *

- ◯ Já ouvi falar
- ◯ Conheço razoavelmente o tema
- ◯ Conheço bem o tema

Já leste o livro "Catástrofes e grandes desastres" de Isabel Alçada e Ana Maria Magalhães? *

- ◯ Ainda não tive oportunidade
- ◯ Li algumas partes
- ◯ Li o livro todo

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Digiral Survey – Part II (after game play). Available at http://goo.gl/forms/u4vbqhEem9ywG5Ia2

# PARTE II - Reação

Experiência controlada, no âmbito do doutoramento em Media Digitais (UNL/UT AUSTIN), a decorrer em três fases distintas:

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2. O jogo. Os alunos experimentam o jogo e tentam avançar nos diferentes níveis;

3. Questionário final, em formato digital, a ser respondido individualmente. Estas questões servem para analisar o que aprenderam, o que acharam de forma geral do jogo e a relação que conseguiram estabelecer com o livro das professoras Isabel Alçada e Ana Maria Magalhães.

*Obrigatório

## Em geral, gostaste de participar no projeto? (indica um valor de 1 a 5 em que 1 significa gostei pouco e 5 gostei muito) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Gostei pouco | ○ | ○ | ○ | ○ | ○ | Gostei muito |

## Em geral, gostaste do formato do jogo? (indica um valor de 1 a 5 em que 1 significa gostei pouco e 5 gostei muito) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Gostei pouco | ○ | ○ | ○ | ○ | ○ | Gostei muito |

Em geral, gostaste do aspeto visual do jogo? (indica um valor de 1 a 5 em que 1 significa gostei pouco e 5 gostei muito) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Gostei pouco | ○ | ○ | ○ | ○ | ○ | Gostei muito |

Em geral, gostaste das personagens? (indica um valor de 1 a 5 em que 1 significa gostei pouco e 5 gostei muito) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Gostei pouco | ○ | ○ | ○ | ○ | ○ | Gostei muito |

Classifica a dificuldade do jogo. (indica de 1 a 5 qual a tua dificuldade para jogar este jogo, sendo que 1 corresponde a muito fácil e 5 a muito difícil) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Muito fácil | ○ | ○ | ○ | ○ | ○ | Muito difícil |

Na tua opinião, em que medida considerarias a informação no jogo adequada para continuar/avançar no jogo? (Responde de 1 a 5 em que 1 significa informação insuficiente ou desadequada e 5 informação completamente adequada) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Informação insuficiente ou desadequada | ○ | ○ | ○ | ○ | ○ | Informação completamente adequada |

## Parte II - Motivação

Qual o nível que mais gostaste? *

- ○ Nível 1 - Grande Incêndio de Londres
- ○ Nível 2 - Terramoto de Lisboa
- ○ Nível 3 - Tsunami no Japão

Qual o nível que menos gostaste? *

- ◯ Nível 1 - Grande Incêndio de Londres
- ◯ Nível 2 - Terramoto de Lisboa
- ◯ Nível 3 - Tsunami no Japão

Gostarias de aprender mais sobre o tema? *

- ◯ Sim
- ◯ Não
- ◯ Não sei / Não respondo

Quantos níveis gostarias que o jogo tivesse? *

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6 ou mais

Numa escala de 1 a 5, consideras o conteúdo do jogo importante? (Responde de 1 a 5 em que 1 pouco importante e 5 muito importante) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Pouco importante | ○ | ○ | ○ | ○ | ○ | Muito importante |

Na tua opinião, em que medida considerarias o jogo como uma forma para aprender? (Responde de 1 a 5 em que 1 significa pouco útil e 5 muito útil) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Pouco útil | ○ | ○ | ○ | ○ | ○ | Muito útil |

## Parte II - Experiência do utilizador

Na tua opinião, em que medida consideras o jogo cativante? (Responde de 1 a 5 em que 1 significa pouco cativante e 5 muito cativante) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Pouco cativante | ○ | ○ | ○ | ○ | ○ | Muito cativante |

Ficaste satisfeito com o jogo? (Responde de 1 a 5 em que 1 significa pouco satisfeito e 5 muito satisfeito) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Pouco satisfeito | ○ | ○ | ○ | ○ | ○ | Muito satisfeito |

Em algum momento quiseste desistir do jogo? *

- ○ Sim
- ○ Não
- ○ Não sei / Não respondo

Em algum momento quiseste desistir do jogo? *

- ◯ Sim
- ◯ Não
- ◯ Não sei / Não respondo

Achas que a tua forma de jogar foi melhorando ao longo do jogo? *

- ◯ Sim
- ◯ Não
- ◯ Não sabe/ não responde

Achas que este jogo oferece novos desafios? *

- ◯ Sim
- ◯ Não
- ◯ Não sabe/ não responde

Gostarias de jogar novamente? *

- ◯ Sim
- ◯ Não
- ◯ Não sabe/ não responde

Na tua opinião, quais são os três pontos fortes do jogo? (escolhe 3 opções) *

- ☐ Personagens
- ☐ História
- ☐ Níveis do jogo
- ☐ Medalhas
- ☐ Quizzes (perguntas)
- ☐ Animações
- ☐ Lutas
- ☐ Gráficos 3D
- ☐ Armaduras
- ☐ Desafios
- ☐ Robots

Na tua opinião, quais são os três pontos fracos do jogo? (escolhe 3 opções) *

- [ ] Personagens
- [ ] História
- [ ] Níveis do jogo
- [ ] Medalhas
- [ ] Quizzes (perguntas)
- [ ] Animações
- [ ] Lutas
- [ ] Gráficos 3D
- [ ] Armaduras
- [ ] Desafios
- [ ] Robots

## Parte II - Aprendizagem

Em que medida concordas com a seguinte afirmação: O jogo ajudou-me a refletir melhor sobre o tema das catástrofes. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: É útil utilizar jogos na sala de aula. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: O jogo acrescentou mais conhecimento ao que tinha. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: O jogo era fácil de compreender e seguir. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: Os quizzes eram fáceis de perceber. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: Aprendi matéria nova com o jogo. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: Consigo lembrar-me das informações apresentadas no jogo. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: Consigo compreender melhor os temas apresentados no jogo. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Em que medida concordas com a seguinte afirmação: Consigo aplicar melhor os temas relacionados com o jogo. (Indica de 1 a 5 a tua concordância com esta afirmação, sendo que 1 corresponde a discordo totalmente e 5 concordo totalmente) *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Discordo totalmente | ○ | ○ | ○ | ○ | ○ | Concordo totalmente |

Comentário/sugestões

A sua resposta

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